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(Continued from page 3 of cover.)

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ALEXANDER W. EVANS.

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SPECIES of *Metzgeria* form a conspicuous part of the hepatic flora of Chile and the neighboring antarctic regions of South America. The first member of the genus to be reported definitely from this general area was the northern *M. furcata* (L.) Dumort., which was listed by Hooker and Taylor in 1844 (**8**, p. 480) under the name *Jungermannia furcata* L. Their report was based on specimens collected by Hooker during the voyage of the "Erebus" and "Terror," the locality being given as St. Martin's Cove, "Cape Horn." Three years later (**27**, p. 445) they gave somewhat fuller details, citing the species from Hermite Island, Cape Horn, and adding that it occurred there not only in the typical form but also as a var. *pubescens*, which they considered the same as the northern *Jungermannia pubescens* Schrank, usually known even at that early date as *M. pubescens* (Schrank) Raddi. In fact Montagne (**13**, p. 214) had already reported *M. pubescens* from the Straits of Magellan, on the basis of specimens collected by Jacquinot. The Synopsis Hepaticarum (**6**, pp. 504, 505), in 1846, accredited *M. furcata* to Cape Horn on the authority of Hooker and Taylor and *M. pubescens* to the Straits of Magellan on the authority of Montagne, but added nothing to the statements of these earlier writers. Four years later Montagne (**14**, p. 297) designated *M. furcata* as a widely distributed species in Chile, without giving definite localities, basing his statement on collections made by Gay.

In 1877 Lindberg published his Monographia Metzgeriae (**10**), in which he made a systematic use of anatomical features in characterizing the species and thus placed the study of the genus on a more scientific basis. Although the authors of the Synopsis recognized nine species in their treatment of *Metzgeria*, five of these really belong to the genus *Riccardia*, thus leaving a residue of only four species. Lindberg increased the number to eleven. Of the forms occurring in the Chilean region he was able to study some of the material collected by Hooker and by Jacquinot. He showed that Hooker's specimens of "*J. furcata* var. *pubescens*" and Jacquinot's specimens of "*Metzgeria pubescens*"

were very distinct from the true *M. pubescens* of the Northern Hemisphere and that they represented an undescribed species. To this he gave the name *M. frontipilis*. He showed further that some of Hooker's specimens of "*J. furcata*" were distinct from the northern *M. furcata* and referred them to his new *M. hamata*, a species having a wide distribution in tropical and temperate regions. He made no definite allusion to Hooker's other specimens of "*J. furcata*" or to Gay's specimens of "*M. furcata*" but stated explicitly that he had seen no material of the true *M. furcata* from the American continent.

In 1885 Massalongo (**11**) issued his report on the Hepaticae collected by Spegazzini in the Fuegian region and recorded new localities for both *M. frontipilis* and *M. hamata*. He likewise restored *M. furcata* to a place in the flora, on the basis of sterile material from Basket Island, and described a new variety of this species from Staten Island under the name *β. decipiens*. This variety was said to be intermediate between the true *M. furcata* and *M. hamata*, and it was suggested that it might represent an undescribed species. In 1889 Bescherelle and Massalongo (**2**, pp. 246, 247) listed *M. frontipilis*, *M. furcata* var. *decipiens*, and *M. hamata* from numerous additional localities in Tierra del Fuego, the Straits of Magellan and southern Patagonia, basing their records on material collected by Savatier, Hariot, and other members of the French Scientific Expedition to Cape Horn. In the following year Schiffner (**16**), in his account of the Hepaticae collected by Naumann of the "Gazelle" Expedition, raised the var. *decipiens* to specific rank, under the name *M. decipiens* (Massal.) Schiffn. & Gottsche, and proposed *M. magellanica* Schiffn. & Gottsche as a new species. Both of these were found at Tuesday Bay in the Straits of Magellan. In addition he reported *M. frontipilis* and "*M. linearis* (Sw.) Lindb." from the same locality and also from Punta Arenas. The "*M. linearis*," however, is not the same as the West Indian *M. linearis* (Sw.) Aust. but is merely a synonym of *M. hamata*, as Lindberg had already shown in his Monographia.

No additional species were reported from the region until 1899, when Stephani published a monograph of *Metzgeria* in the first volume of his Species Hepaticarum (**19**). In this important contribution he recognized *M. frontipilis*, *M. furcata*, and *M. hamata* as members of the flora but reduced *M. magellanica* to synonymy under *M. nitida* Mitt. (**12**, p. 243), a species based on Australian and New Zealand material, and expressed the opinion that *M. decipiens* probably represented another synonym of the same species. A third species that he included among the synonyms of *M. nitida* was his own *M. australis*

(**18**, p. 266), which had been described from specimens collected on Lord Howe's Island and in Australia. Two other well-known species that he accredited to the Chilean flora were the northern *M. conjugata* and *M. Liebmanniana* Lindenb. & Gottsche, a species originally known from Mexico. His record for *M. Liebmanniana* was based on a specimen collected at Valdivia by Hahn, and his record for *M. nitida* on Naumann's material from the Straits of Magellan. Most of his other data are more general, *M. conjugata* and *M. furcata* being cited merely from "Chile," *M. hamata* from "Patagonia" and *M. frontipilis* from the Straits of Magellan and "Chile." Under *M. furcata* and *M. hamata* he made no mention of Hooker as a collector and failed to cite either Hooker or Jacquinot in connection with *M. frontipilis*. He therefore gave no information regarding the earliest specimens of *Metzgeria* found in the region, including those upon which Lindberg's records were based.

In addition to the species already mentioned Stephani proposed as new no fewer than ten Chilean species, although he assigned to three of these a range extending far beyond the boundaries of the region. These species are the following, only the Chilean stations being indicated: *M. angusta*, "Chile" and Patagonia (*Dusén*); *M. chilensis*, "Chile" (*Dusén*); *M. corralensis*, Corral (*Krause*); *M. decrescens*, "Straits of Magellan" (*Dusén*); *M. Dusenii*, Desolation Island (*Dusén*); *M. glaberrima*, Straits of Magellan (*Spegazzini, Dusén*, "Gazelle" Expedition) and "Chile" (*Gay, Krause*); *M. Lechleri*, Arique (*Lechler*); *M. longiseta*, Straits of Magellan (Warnstorf Herbarium); *M. patagonica*, Newton Island (*Dusén*); and *M. terricola*, Straits of Magellan (*Savatier, Dusén*). It will be noted that Spegazzini and the "Gazelle" Expedition are mentioned in connection with *M. glaberrima* and that Savatier is named as one of the collectors of *M. terricola*. Since the collections of Spegazzini, Naumann and Savatier had already been reported upon (see **11**, **16**, and **2**), it is evident that the authors of these reports must have listed *M. glaberrima* and *M. terricola* under other names or else have made no allusion to the specimens here cited. Unfortunately Stephani throws no light upon these doubtful points. It will be noted further that more than half of the new species were based wholly or in part on material collected by Dusén. In regard to some of this material Stephani has given fuller details about localities in two subsequent papers (**21** and **22**), published respectively in 1900 and 1901.

In the first of these papers he listed *M. australis* as a valid species, apparently no longer regarding it as a synonym of *M. nitida*, and

accredited it to Corral. He likewise cited *M. Dusenii* from the same locality and described *M. brevialata* from San Pedro Island as a new species. In the second paper he listed *M. pubescens* from Tierra del Fuego, although in his monograph he had restricted it to the Northern Hemisphere. Other data regarding stations will be noted later in connection with individual species. Strange to say Stephani made no mention in either paper of *M. chilensis*, *M. decrescens*, or *M. terricola*, in spite of the fact that he had used Dusén's specimens in drawing up the original descriptions of these species. It might at first appear that he had repudiated them, but this is clearly not the case, so far as *M. chilensis* and *M. terricola* are concerned, because he has referred to both of them in his later writings. In 1901, for example, he reported *M. chilensis* from Clarence Island in the Straits of Magellan (**22**, p. 4); in 1911 he reported the same species from Chiloé and Juan Fernandez (**23**, p. 10); and in 1916 he reported *M. terricola* from Bolivia (**25**, p. 180). These reports were based on specimens collected by Racovitza, Skottsberg and Herzog, respectively. In his report on Skottsberg's ample Chilean collections Stephani cited new stations for several other species of *Metzgeria* and also listed, as an addition to the flora, *M. albinea* Spruce, previously known from a single locality in Brazil. His record was based on a specimen from Huafo Island. In 1917 (**26**, p. 47) he made his last contribution to our knowledge of the Chilean *Metzgeriae* by proposing as a new species *M. antarctica* from Punta Arenas, basing his description on a specimen collected by Von Schrenk. According to his published writings Stephani recognizes twenty species of *Metzgeria* as members of the flora.

As in other large and natural genera of plants the species of *Metzgeria* are often difficult to distinguish. This is partly because most of the differential characters are drawn from variable structures and partly because the plants sometimes remain for a long time in an embryonic or juvenile stage of development, during which certain of the specific features fail to reveal themselves. Var. *ulvula* Nees of *M. furcata*, as shown by Goebel (**5**), is an excellent example of this condition, and equally good examples occur among the Chilean species. One unfortunate result of the difficulties involved in the determination of specimens has been an accumulation of incorrect records, not only in herbaria but also in the literature. This has been strikingly shown by Schiffner (**17**) in the case of *M. dichotoma* (Sw.) Nees, a species first described in 1788 and therefore one of the earliest to be recognized. In the Lindenberg Herbarium at Vienna he found eleven specimens bearing this name. Three of these were from Jamaica and represented

original material of *Jungermannia dichotoma* from the Swartz collections; the others came from Guadeloupe, St. Vincent, Mexico, Brazil and Peru. The Jamaican specimens were the only ones that included plants of the true *M. dichotoma*, as this species is now understood, and two of these contained an admixture of *M. hamata;* the eight remaining specimens represented seven distinct species, three of which were at that time undescribed. In the Stephani Herbarium, now at Geneva, Schiffner found eight specimens bearing the name *M. dichotoma*, all of which had been collected in Brazil. Not one of these represented the true *M. dichotoma*. They represented instead three distinct species, not duplicated in the Lindenberg Herbarium. These two authoritative herbaria, therefore, which have served as the basis for many printed records, contained ten different species that had been incorrectly determined as *M. dichotoma*.

In view of these facts the writer has made an attempt to obtain for examination a full series of Chilean *Metzgeriae* and especially of specimens upon which printed reports have been based. This has been made possible through the kindness of correspondents and the curators of herbaria, and the writer would express his sincere thanks to all who have assisted him in his work. As a result of this study seven of the species based on Chilean material are reduced to synonymy, two species are proposed as new, and several incorrect determinations are rectified. These various changes reduce the number of known species to eleven, although certain fragmentary and undeterminable specimens indicate that this number is too low. In the citation of specimens the following abbreviations are used: B, Stephani collection in the Boissier Herbarium, University of Geneva; H, Cryptogamic Herbarium of Harvard University; M., Mitten Herbarium, at the New York Botanical Garden; Massal., collection of Professor Massalongo at Verona; Möll., collection of Dr. Möller at Stockholm; N. Y., herbarium of the New York Botanical Garden; S., collection of Professor Schiffner at Vienna; St., herbarium of the Swedish National Museum at Stockholm; U., herbarium of the University of Upsala; Y, herbarium of Yale University (including the private collection of the writer).

Key to the Species.

a. Upper surface of thallus densely covered with hairs
1. *M. frontipilis* (p. 276).

a. Upper surface of thallus naked ..... *b.*

b. Costa bounded dorsally, on robust thalli, by more than two rows of cortical cells ..... *c.*

b. Costa bounded dorsally by only two rows of cortical cells ..... *d.*

c. Ventral surface of wings naked, the ventral hairs (when present) being restricted to the costa; gemmae lacking 2. *M. decrescens* (p. 279).
c. Ventral surface of thallus, including the wings, more or less densely covered with hairs; gemmae dorsal . . 3. *M. corralensis* (p. 285).
d. Costa bounded ventrally by four rows of cortical cells; gemmae marginal . . . . . *e.*
d. Costa bounded ventrally by only two rows of cortical cells . . . . . *f.*
e. Marginal hairs often in divaricate pairs; ventral surface of wings usually with scattered hairs . . . . . 4. *M. divaricata* (p. 288).
e. Marginal hairs borne singly; ventral surface of wings naked. 5. *M. patagonica* (p. 291).
f. Gemmae lacking . . . . . *g.*
f. Gemmae present, borne on more or less specialized branches becoming narrower toward the tips . . . . . *i.*
g. Thallus plane or nearly so; marginal hairs usually borne singly and sometimes scantily developed or lacking . . . . . *h.*
g. Thallus convex, the wings more or less revolute . . . . . *j.*
h. Autoicous . . . . . 6. *M. chilensis* (p. 294).
h. Dioicous . . . . . 7. *M. decipiens* (p. 296).
i. Plants not turning bluish when dried; thallus and gemmae plane or nearly so . . . . . 8. *M. epiphylla* (p. 303).
i. Plants turning bluish when dried; thallus and gemmae more or less convex . . . . . 9. *M. violacea* (p. 306).
j. Marginal hairs borne singly and often scantily developed. 10. *M. magellanica* (p. 313).
j. Marginal hairs usually in pairs . . . . . 11. *M. hamata* (p. 315).

1. METZGERIA FRONTIPILIS Lindb.

Metzgeria frontipilis Lindb. Acta Soc. F. et Fl. Fenn. **1**[2]: 14. *pl. 1, f. 2.* 1877.
Metzgeria brevialata Steph. Bihang K. Svenska Vet.-Akad. Handl. **26**[3] (No. 6): 20. 1900.

SPECIMENS EXAMINED: Newton Island, May, 1896, *Dusén*, mixed with *113* (B., St., U., see **20**, p. 19); San Pedro Island, *Dusén 533* (Möll., type of *M. brevialata*); shores of Trinidad Canal, *Coppinger* (M.); York Bay, September, 1853, *Lechler 1354* (M., as *M. pubescens*); same locality, *Lechler* (N. Y., as *M. pubescens* var. *subglabra*); southern part of Smith Sound, near the entrance to the Straits of Magellan, 1883, *Görtner*, mixed with *Riccardia fuegiensis* and other bryophytes (Y., specimen received from the Warnstorf Herbarium); Puerto Angosto, Desolation Island, March, 1896, *Dusén*, mixed with *159* (B., M., St., U., see **21**, p. 10); Straits of Magellan, 1868, *Dow* (Y.); Rio Azopardo, Tierra del Fuego, March, 1896, *Dusén 72* (U., as *M. pubescens*, and listed under this name by Stephani, **21**, p. 10); without definite locality, Tierra del Fuego, 1896–97, *Hatcher* (Y., **3**, p. 426); Cape Horn, *Hooker* (M., **10**, p. 15; listed as *Jungermannia furcata β.*

pubescens by Taylor and Hooker, **27**, p. 445); Staten Island, 1882, *Spegazzini 65* in part (Massal., Y., **11**, p. 257).

The following additional stations may be cited from the literature: Hanover and Atalaya Islands, *Skottsberg* (**24**, p. 10); Clarence and Hoste Islands, *Hariot* (**2**, p. 247); Tuesday Bay and Punta Arenas, Straits of Magellan, *Naumann* (**16**, p. 43); Brecknock Pass, *Spegazzini* (**11**, p. 257); Tekenika Bay, Almirantazgo, and Lake Fagnano, Tierra del Fuego, *Skottsberg* (**23**, p. 9, and **24**, p. 10); Mount Sarmiento, Tierra del Fuego, *Spegazzini* (**11**, p. 257).

The presence of hairs on the dorsal surface of the thallus is the most remarkable feature of *M. frontipilis* and will at once distinguish it from all the other known species of the genus except *M. pubescens*. In the northern species, however, the thallus is scarcely convex and the hairs are equally abundant on the ventral surface, being situated on both costa and wings; whereas in *M. frontipilis* the thallus is usually distinctly convex and the ventral hairs are largely restricted to the costa, the wings being almost or entirely free from them. To a certain extent the female branches offer an exception to this description, so far as the arrangement of the hairs is concerned, since in these both surfaces are equally hairy throughout. The male branches are still unknown.

Other noteworthy characters are derived from the costa and especially from its cortical cells, which show marked variations in number. According to Lindberg's original account these cortical cells are in eight to twelve rows both dorsally and ventrally. Stephani (**19**, p. 932), with a larger series of specimens at his disposal, places the extremes at six and eighteen and associates the lower numbers with the branches and the higher with the main axis. As a matter of fact only four rows are present in some of the slender branches studied by the writer. Stephani brings out in addition the interesting fact that the wings are sometimes two or three cells thick at their junction with the costa, a feature overlooked by Lindberg.

Although the published descriptions of *M. frontipilis* state emphatically that the ventral surface of the wings is wholly naked, this condition is by no means always realized. The hairs show a tendency to encroach, as it were, upon the ventral surface, not only from the margins but also (less frequently) from the costa. This tendency sometimes expresses itself by a very slight displacement of the marginal hairs, so that they are not truly marginal (FIG. 1, A); but the displacement may be much more marked than this, so that the hairs appear on the ventral surface one, two, three or even four cells away

from the margin. Occasional hairs of this type are to be expected on almost any thallus, but it is usually difficult to detect them, except in section, on account of the revolute wings. When such hairs are more abundant forms are produced like Dusén's specimens from the Rio Azopardo, which Stephani referred to *M. pubescens*. A comparison of these specimens with European material of *M. pubescens* shows at once that the two plants are not the same. In the Rio Azopardo specimens, the greater part of the ventral surface of the wings is still free from hairs, and the thallus shows the marked convexity characteristic of *M. frontipilis*.

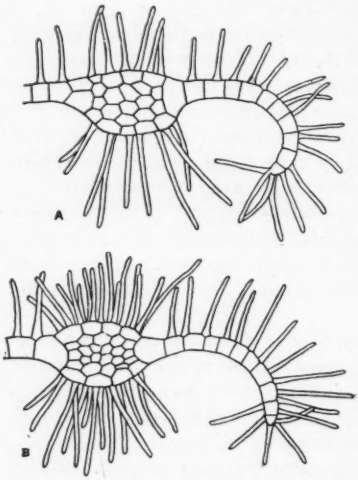

FIG. 1. METZGERIA FRONTIPILIS Lindb.

A, B. Transverse sections of rather slender thalli, × 100. A was drawn from a specimen collected on Desolation Island by Dusén, No. 159 in part; B, from the type material of *M. brevialata*.

The plants from San Pedro Island, upon which Stephani based his *M. brevialata*, represent a more aberrant type. According to his description the most important features of this species are the following: a large costa, bounded both dorsally and ventrally by ten rows of cortical cells on the main axes and by four rows on the ultimate branches; narrow wings, unistratose throughout and only slightly decurved, ten cells wide on the ultimate branches but only five cells wide on the main axes; and an abundance of hairs on both surfaces of costa and wings. The plants show that the description is essentially correct in most respects except that the numbers of cortical and alar cells are less definite than is implied. The thalli exhibit, however, two marked discrepancies, when compared with his description. In the first place the wings are not always unistratose throughout but may be bistratose at their junction with the costa; and in the second place the wings, except when very narrow, are distinctly decurved and show a broad band next to the costa entirely free from ventral hairs. The latter, to be sure, are abundant and show the

extreme displacement noted above (FIG. 1, B), some of the hairs being three or four cells distant from the margin; but it is only on the narrowest wings that they are scattered over the entire ventral surface. The writer feels, therefore, that these specimens, although at first sight so striking, can not be separated specifically from *M. frontipilis*. They apparently represent a xerophytic modification of the species, both the narrow wings and the abundant hairs being in accordance with this view. It may be noted also in this connection that *M. pubescens* sometimes produces thalli with exceedingly narrow wings. Specimens showing this feature in a marked degree were discovered by Kaalaas near Christiania, Norway, and distributed by Schiffner in his Hepaticae Europaeae, No. 21, as forma *attenuata*. On some of the ultimate branches the wings are so strongly narrowed that they almost disappear, and the thalli thus acquire an appearance very different from that of typical *M. pubescens* with its broad wings.

2. METZGERIA DECRESCENS Steph.

Metzgeria decrescens Steph. Bull. Herb. Boissier **7**: 932. 1899.
Metzgeria terricola Steph. op. cit. 933. 1899.
Metzgeria longiseta Steph. op. cit. 934. 1899.
Metzgeria Dusenii Steph. op. cit. 942. 1899.

SPECIMENS EXAMINED: valley of the Aysen River, January, 1897, *Dusén 416* (M., TYPE; Möll., St., Y., as *M. glaberrima*, and listed under this name by Stephani, **20**, p. 20); Newton Island, May, 1896, *Dusén 113* in part (B., as *M. terricola*, and listed under this name by Stephani, **19**, p. 934; St., U., as *M. Dusenii*); southern part of Smith Sound, near the western entrance to the Straits of Magellan, 1883, *Görtner*, mixed with *Riccardia fuegiensis* and other bryophytes (Y., specimen received from the Warnstorf Herbarium); Alert Bay, western coast of Patagonia, 1882, *Coppinger* (N. Y.); Churucca, Desolation Island, *Savatier* (B., presumably the type of *M. terricola*, but listed as *M. furcata* var. *decipiens* by Bescherelle & Massalongo, **2**, p. 246); Puerto Angosto, Desolation Island, March, 1896, *Dusén 159* in part (M., St., U., type of *M. Dusenii*); Straits of Magellan, July, 1885, collector unnamed (B., type of *M. longiseta*, specimen received from the Warnstorf Herbarium); Cape Horn, *Hooker*, mixed with *M. decipiens* (M.).

The following additional station may be cited from the literature: Corral, *Dusén* (**20**, p. 19, as *M. Dusenii*).

In his monograph of the genus *Metzgeria* (**19**) Stephani divides the

species into the two groups *Pinnatae* and *Furcatae*. Unfortunately, as Schiffner has since emphasized (**17**, p. 184), the distinction between these groups is based on variable features, since a thallus may be more or less pinnate in one part and distinctly furcate in another. Even in the more typically pinnate species, such as *M. filicina* Mitt. of the Andes, *M. pubescens* and *M. frontipilis*, the differentiation between an axis and its branches is relatively slight and expresses itself quantitatively rather than qualitatively. In certain species which Stephani includes among the *Pinnatae*, such as *M. decrescens*, he utilizes these quantitative differences in determining the relative rank of the branches in a branch-system. In the main axis of *M. decrescens*, according to his description, the costa is bounded dorsally by five rows of cortical cells and below by seven; in the pinnae (or branches of the first rank) the numbers are four and five, respectively; while in the pinnules (or branches of the second rank) the costa is bounded both dorsally and ventrally by two rows of cortical cells. He describes further a decrease in the width of the wings, corresponding with this decrease in the number of cortical cells. Apparently on the basis of these differences he states that the thallus is irregularly pinnately branched and adds that long pinnae and pinnules are mixed with much shorter ones.

A careful study of the type specimen of *M. decrescens* in the Mitten Herbarium shows that a pinnate habit is not apparent and that the branches arise in the usual dichotomous manner. These branches, to be sure, show the differences described by Stephani, and there are also intermediate conditions connecting his three types; but these differences do not by any means determine the relative rank of the branches. When an axis forks, for example, either or both of the branches may have a more complex costa and broader wings than the original axis, and the costa of a branch may increase in complexity with its growth in length. The differences are apparently due to nutritive causes and merely indicate that the costa and wings are variable with respect to the number of their component cells.

The plants of *M. decrescens* are whitish or yellowish green and apparently grow in dense mats. The living portion of the thallus may reach a length of 4–5 cm., while the width is mostly 0.9–1.3 mm. The wings are so strongly revolute that their margins sometimes meet, the thallus thus acquiring a cylindrical or subcylindrical form. The successive dichotomies may be as much as 1 cm. apart or as little as 1 mm., an individual thallus rarely showing both extremes. According to Stephani the ventral surface is naked, the hairs being restricted

to the margin. In most cases this description applies, but occasionally a few scattered hairs arise from the ventral surface of the costa. The crowded marginal hairs, as he notes, occur singly and are usually straight. In well-developed plants a hair (FIG. 2, A) is found between every two marginal cells, and when the revolute wings approach each other closely the hairs form a delicate weft between them, making it difficult to study the features of the costa without spreading the wings

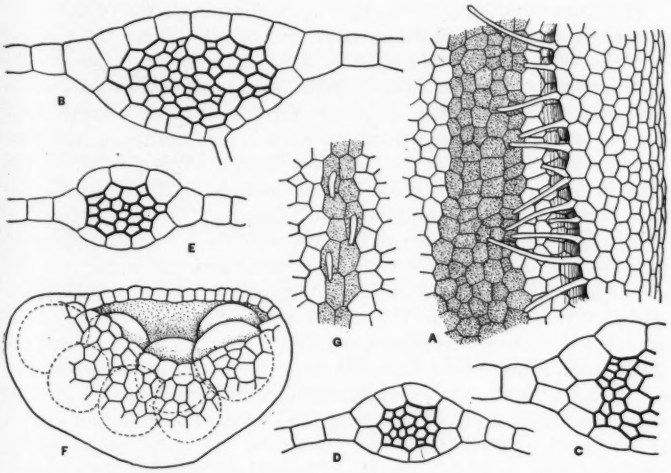

FIG. 2. METZGERIA DECRESCENS Steph.

A. Part of a slender thallus, ventral view, × 50; there are only two or three rows of cortical cells, the external stippled row on each side representing a bistratose transition-region between costa and wings. B–E. Transverse sections of costae, × 100. F. Male branch, × 100. G. Costa and adjacent alar cells of a male branch, showing slime-papillae, × 100. The figures were all drawn from the type material.

apart. The hairs are mostly 0.2–0.4 mm. long and 10–20 μ in width, tending to taper from the base.

The alar cells have thin or slightly thickened walls, and trigones are either absent or minute and inconspicuous. Stephani gives the size of the cells as 54 × 45 μ. According to the writer's measurements the average size of the cells in the type specimen is about 45 × 34 μ, while the general average derived from the eight specimens listed

above is 43 × 33 μ. At the same time one specimen gave an average as high as 55 × 35 μ, so that Stephani's figures are not excessive. The lowest average obtained was 36 × 32 μ. It should be remembered in this connection that, in species of *Metzgeria*, considerable variation in the size of the cells is to be expected, not only when different thalli, but also when different parts of the same thallus are compared. Data derived from cell-measurements must therefore be used with caution in distinguishing species.

The costa of *M. decrescens* (Fig. 2, B–E) yields some of the most distinctive characters of the species. It not only shows the marked variation in the number of cortical cells, to which attention has already been called, but it often shows in addition another feature unusual in the genus. In most of the *Metzgeriae* the transition between the unistratose wings and the multistratose costa is very abrupt, a condition clearly shown in many of the published figures. When, however, the costa is large and complex, as it is for example in *M. frontipilis*, the transition between the wings and the costa may be more gradual, a narrow band of large cells two or three cells thick being interpolated between the unistratose portion of a wing and the costa. In *M. decrescens*, although the costa is not particularly complex, both types of structure occur, just as they do in *M. frontipilis*. In some of the branches the abrupt transition is present (Fig. 2, E), in others the gradual transition (Fig. 2, B–D), and the latter is not necessarily associated with the more complex costae. When there is a gradual transition this is usually clearly apparent even when an intact thallus is examined. Under these circumstances the costa seems to be poorly defined, and the bistratose or tristratose band becomes evident by careful focusing, the outlines of the cells in the superimposed layers not corresponding.

The type material of *M. decrescens* shows male branches in abundance but no female branches. The male branches, which seem to be the only ventral branches present, have involute margins and are strongly incurved, although the apex does not approach the base very closely (Fig. 2, F). They measure about 0.45 × 0.3 mm. in well-developed examples and are wholly destitute of hairs, the only appendicular organs developed being the slime-papillae (Fig. 2, G). The alar cells are more delicate than those of a vegetative thallus and average only 25 μ in diameter. In some of the other specimens studied a few female branches with calyptras were found. These organs bore scattered hairs and attained a length in some cases of 3–3.5 mm., the diameter being 0.6–0.8 mm. Unfortunately the

female branches themselves were so old and battered that their distinctive features could not be determined.

The three synonyms included under *M. decrescens* may now be considered. The first, *M. terricola*, was based on two specimens, one collected by Savatier on Desolation Island and the other by Dusén on Newton Island. According to Stephani *M. terricola* shows a variability in the number of cortical costal cells, comparable with what is found in *M. decrescens*. The wings of the thallus, moreover, are revolute in much the same way, while the cells are said to average about $54 \times 36\,\mu$, measurements which diverge but slightly from those given for *M. decrescens*. The following represent the most important differential characters indicated: the presence of a few setulae on the ventral surface of the thallus and the occurrence of the marginal hairs in pairs.

In Savatier's specimens, which may perhaps be regarded as the type, the costa is essentially like that of the type specimen of *M. decrescens;* and, although ventral hairs are sometimes present on the costa, this is equally true of *M. decrescens*. The marginal hairs, moreover, so far as the writer can determine, are invariably borne singly. In Dusén's material some of the thalli are like Savatier's, but others show crowded marginal cilia in pairs. The latter, however, are associated with costae that are bounded constantly, both dorsally and ventrally, by only two rows of cortical cells, while the cells of the revolute wings are considerably larger, averaging about $70 \times 40\,\mu$. In the writer's opinion the thalli with the geminate marginal hairs should be referred to *M. hamata*, although they evidently formed a part of the material from which the description of *M. terricola* was drawn. If these thalli are eliminated there is apparently nothing whatever to distinguish *M. terricola* from *M. decrescens*. The writer regrets that he has not seen Herzog's specimens of "*M. terricola*," to which allusion has already been made (see page 274).

The second synonym, *M. longiseta*, was based on a specimen from the Straits of Magellan, the collector's name not being given. In his account of this species Stephani calls attention to the strongly convex thallus, the variable number of cortical costal cells, the long marginal hairs borne singly, and the alar cells averaging about $54 \times 36\,\mu$, four characters which *M. longiseta* clearly shares with *M. decrescens*. He mentions also the fact that the wings are two or three cells thick near the costa. This, as has been shown, is another characteristic feature of *M. decrescens*, although the original description does not allude to it. The differential characters of *M. longiseta* are apparently drawn

from the marginal hairs, which are described as "hamate," and from the costa. The latter is said to be strongly convex dorsally and nearly plane ventrally and to have a thickness of five cells. The dorsal cortical cells, furthermore, are said to be convex and much larger than the internal and ventral cortical cells, which are said to be subequal in size. Unfortunately the type specimen does not support this description very convincingly. The marginal hairs are very rarely hamate, most of them being straight or irregularly curved and contorted; while the costa, as shown by cross sections, may project ventrally slightly more than dorsally. The dorsal cortical cells, moreover, measure about 50 μ in width, the ventral about 40 μ, and the internal cells, which may be in more than three layers, measure about 30 μ. These observations show that Stephani's differential characters are far from constant, and yet with the withdrawal of these his descriptions of *M. longiseta* and *M. decrescens* are almost identical.

Although the first two synonyms of *M. decrescens* are placed by Stephani among the *Pinnatae*, the third, *M. Dusenii*, is placed among the *Furcatae*. It is based upon material collected by Dusén on Desolation Island and the three original specimens examined have all been badly mixed with *M. frontipilis*. Stephani's description of *M. Dusenii* would seem to indicate that the species was much less variable in its costal features than *M. decrescens*, since the cortical cells are said to be in four rows both dorsally and ventrally. It is added that the dorsal surface is convex and the ventral smooth, that costal hairs are lacking, that the dorsal cortical cells are large and projecting, and that the ventral cells are much smaller. The original material shows at once the inconstancy of these features. Although some of the thalli show four rows of cortical cells on both surfaces, deviations from this number are frequent; some of the branches, for example, show only two or three such rows, while five rows of ventral cells were observed in at least one instance. Costal hairs, moreover, can be demonstrated by careful search in spite of their great infrequency, and they are really not much rarer than in the type of *M. decrescens*. The costal cells, finally, show deviations from the description. In a series of sections examined by the writer, the costa was found to be distinctly convex ventrally, while the ventral cortical cells measured 38 μ in width and were thus only slightly narrower than the dorsal cells, which measured 42 μ. Aside from the characters which have just been discussed the description of *M. Dusenii* agrees in all essential respects with that of *M. decrescens*, since the thallus is said to be strongly convex with naked wings and long marginal hairs borne singly, while the alar cells

are said to average about $45 \times 36\,\mu$. The Desolation Island specimens are perhaps a trifle less robust than the type of *M. decrescens* from the Aysen Valley, and the branches tend to be shorter, but these differences are too slight and too inconstant to be of much significance.

It is interesting to note that Dusén's material from Newton Island, No. 113, has been differently determined by Stephani at different times. The specimen in the Boissier Herbarium bears the name *M. terricola*, while those at Stockholm and Upsala bear the name *M. Dusenii*. In the writer's opinion, as indicated above, these specimens are clearly the same and represent *M. decrescens*. It might appear from his determinations that Stephani recognized the identity of his *M. terricola* and *M. Dusenii* and wished to supplant one name by the other. Unfortunately this assumption is contradicted by his published writings.

3. METZGERIA CORRALENSIS Steph.

Metzgeria corralensis Steph. Bull. Herb. Boissier **7**: 933. 1899.
Metzgeria Lechleri Steph. op. cit. 942. 1899.

SPECIMENS EXAMINED: without definite locality or date, *Gay* (Mont., as *M. furcata*, and listed under this name by Montagne, **14**, p. 297); Corral, no date, *Krause* (B., TYPE); Arique, no date, *Lechler 652* (M., unnamed but probably representing the type of *M. Lechleri*); Valdivia, 1887–88, *Hahn* (B., as *M. Liebmanniana* and listed under this name by Stephani, **19**, p. 935); same locality, date and collector (B., apparently a part of the same collection as the preceding but bearing a manuscript name); Osarno Volcano, date and collector's name not given (M.).

Stephani places *M. corralensis* among the *Pinnatae* and describes the thallus as remotely pinnate. At the same time he makes no allowance for variability in the number of costal cells, as he did in *M. decrescens*, stating definitely that the dorsal cortical cells are in four rows and the ventral in eight. The type specimen shows that these numbers are too rigid. Although the dorsal cortical cells are usually in four rows (FIG. 3, A, B), the number really varies from two to five, and the ventral rows are frequently fewer than eight (FIG. 3, B). In spite of this variability a pinnate habit is no more apparent in *M. corralensis* than in *M. decrescens*.

The species varies in color from a pale yellowish green to a dull green and is fairly robust. According to Stephani the thallus sometimes attains a length of 4 cm. The width is mostly 1–1.5 mm. but

may be as much as 2.5 mm. in well-developed plants. The wings are plane or somewhat convex and are mostly fifteen to twenty-five cells across in the type material, although Stephani gives the width as only twelve cells. According to his statements the alar cells measure $36 \times 27\ \mu$, and these figures agree pretty closely with the general average of $33 \times 26\ \mu$, obtained from the five specimens listed above. The cells, as he notes, are essentially thin-walled throughout, although vague indications of trigones are sometimes present.

In well-developed thalli the whole ventral surface, including both the costa and the wings, is covered over with crowded hairs, giving it a pubescent appearance. These hairs are mostly 0.1–0.3 mm. in

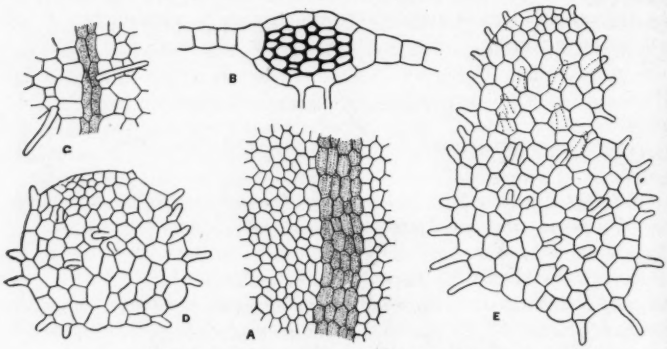

FIG. 3. METZGERIA CORRALENSIS Steph.

A. Part of a thallus showing costa and adjoining cells of wings, dorsal view, × 50. B. Transverse section of costa, × 100. C. Costa and adjoining alar cells of a male branch, showing ventral hairs, × 100. D. Gemma at time of separation, × 100. E. Germinating gemma, × 100. A, D and E were drawn from a specimen collected on the Osarno Volcano; B and C, from a specimen collected at Arique by Lechler.

length and 10–12 μ in diameter. Those along the margin, which are essentially like the others, sometimes spread widely and sometimes grow downward; they usually arise singly, as Stephani notes, but twinned hairs may occasionally be demonstrated. Between the densely pubescent ventral surface, which is doubtless typical for the species, and a smooth or nearly smooth condition, all gradations occur, although it is doubtful if a thallus is ever smooth throughout.

In the specimens studied by the writer a few male branches are present and are mostly 0.2–0.35 mm. in length by 0.25–0.4 in width. The

wings are involute and the costa so strongly incurved that the apex almost reaches the base, the branch thus acquiring a spherical or subspherical form. According to Stephani the surface is smooth, but this is rarely the case, from one to a dozen hairs being usually present (FIG. 3, C).

If Stephani's descriptions of *M. Lechleri* and *M. corralensis* are compared it will be seen that they agree in most important respects, even though he places *M. Lechleri* among the *Furcatae*. The most important differences that he brings out are derived from the costae and alar cells, the features of which in typical *M. corralensis* have already been discussed. According to his description the costa of *M. Lechleri* is bounded both dorsally and ventrally by four rows of cortical cells, while the alar cells have firm walls distinctly thickened at the angles. The study of Lechler's Arique specimens in the Mitten Herbarium, which agree in most respects with Stephani's description, brings out the fact that the cortical costal cells are inconstant in number, just as in *M. corralensis*. The alar cells, moreover, although slightly thickened, do not show conspicuous trigones; in fact it is usually difficult to make them out at all. Since the differences between the species thus break down, and since the Arique specimens are essentially like Krause's type, the writer feels convinced that the two species are synonymous.

The importance of gemmae in distinguishing species of *Metzgeria* has already been emphasized by the writer in another connection (**4**). In *M. corralensis* the gemmae are dorsal and are borne on ordinary vegetative branches, the growth of which is apparently unlimited. As in *M. crassipilis* (Lindb.) Evans of the eastern United States (see **4**, p. 282) and other species having dorsal gemmae, many thalli are not gemmiparous at all, while others produce the gemmae in great profusion. In the case of *M. corralensis* the early stages of development have not been studied, but their adult features will be described.

At the time of separation (FIG. 3, D) the gemmae vary somewhat in size but most of them are 0.18–0.27 mm. long and 0.16–0.24 mm. wide; they may be orbicular, but the width is usually a little less or a little more than the length. A gemma is six to eight cells across and has a single apical cell. What may be described as the dorsal surface is convex and usually shows from two to six short and rudimentary hairs. The gemma bears in addition from three to eight marginal hairs on each side, and these may be truly marginal or slightly displaced to the ventral surface, which seems otherwise to be perfectly smooth.

When a gemma germinates its apical cell continues (or resumes) its activities and gives rise to a flat, strap-shaped thallus which tends to be narrower than the gemma itself (FIG. 3, E) being often only four cells wide. While this is going on the hairs on the gemma increase somewhat in length, and similar superficial and marginal hairs appear on the flat extension. The superficial hairs are always more numerous on one surface than on the other and may be confined to one surface. Sometimes the more hairy surface of the extension is continuous with the hairy convex surface of the gemma and sometimes with the smooth concave surface, these observations apparently showing that the dorsiventrality of the gemma is not firmly fixed but that a reversal of the dorsiventrality may take place at germination.

The presence of superficial hairs on the gemmae of *M. corralensis* and on the young thalli to which they give rise are perhaps the most distinctive features of these structures. Except for these peculiarities the gemmae and young plants are much like those of *M. crassipilis* and *M. Liebmanniana*. The latter species, in fact, is closely related to *M. corralensis*, differing from it mainly in its greater size; and it is therefore not surprising that specimens of the Chilean species have been referred to *M. Liebmanniana*.

4. **Metzgeria divaricata** sp. nov.

Grayish or yellowish green, scattered or growing in depressed mats, more or less firmly attached to the substratum: thallus prostrate, repeatedly dichotomous but rarely branching ventrally, plane or slightly convex, well-developed thalli mostly 0.6–1.2 mm. wide, the forks mostly 2–8 mm. apart; costa bounded dorsally by two rows of cortical cells and ventrally by four; wings mostly eight to fifteen cells broad, the cells mostly 38 × 31 μ, the walls thin or slightly thickened and sometimes with more or less distinct trigones and nodular intermediate thickenings; hairs varying greatly in abundance; marginal hairs in the hairiest and most characteristic plants occurring in divaricate pairs, ventral hairs under these circumstances numerous on the wings and especially on the costa; hairs averaging about 0.15 mm. in length and 10–12 μ in width, often branched at the apex and acting as rhizoids: inflorescence dioicous: ♂ branches sometimes borne in considerable abundance, subspherical, usually bearing on the ventral surface from one to five scattered hairs, 0.33–0.36 mm. long and 0.33–0.45 mm. in width: ♀ branch broadly obcordate, 0.25–04. mm. long and 0.45–06. mm. wide, hairs abundant along the margin

and also scattered over the ventral surface, especially in the median part; calyptra about 2 mm. long and 0.9 mm. wide, more or less hairy throughout but especially in the upper half: gemmae rarely abundant, marginal, borne on undifferentiated branches, oblong, flat or nearly so, usually with crowded rudiments of marginal and sometimes paired hairs slightly displaced to one surface.

SPECIMENS EXAMINED: Chile, without definite locality or date, *Neger 68* (B., as *M. conjugata*, and listed under this name by Stephani, **19**, p. 951); near Santiago, 1882, *Philippi 24* (B., as *M. furcata*, and listed under this name by Stephani, **9**, p. 941); Concepcion 1905–06, *Thaxter 90, G* (H., Y.); San Antonio, Pudeto River, Chiloé, July, 1908, *Halle & Skottsberg 257* (U., as *M. Lechleri*, and listed under this name by Stephani, **24**, p. 10). No. 90, collected by Professor Roland Thaxter, may be designated the type; No. 257, from Chiloé, is poorly developed and somewhat doubtful.

In *M. divaricata* and the species that follow the structure of the costa is far more constant than in *M. frontipilis*, *M. decrescens* and *M. coralensis*. This does not mean that an absolute constancy is to be expected. In *M. divaricata*, for example, the ventral cortical cells may be in five rows instead of four, even at some little distance from a fork; it simply means that deviations from the typical numbers are infrequent enough to be ignored.

As noted in the description the ventral hairs vary greatly in abundance. In the more extreme development of these hairs the entire ventral surface appears loosely pubescent, and the marginal hairs occur between every two marginal cells. In typical cases these marginal hairs are paired and spread so widely apart that they form a straight line perpendicular to the margin. As a rule the outer hair of each pair is truly marginal and the inner ventrally displaced. Sometimes, however, the outer hair is slightly displaced too, and a semblance of displacement is often brought about by the slight convexity of the wing-margins. When a long series of these paired and divaricate marginal hairs is present the thallus acquires a very striking and distinctive appearance (FIG. 4, A). Unfortunately the condition just described is not always realized. Sometimes, for example, one part of a thallus may be pubescent, while other parts produce hairs sparingly or not at all. An entire thallus, in fact, may be sparingly hairy throughout, and most of the marginal hairs present may be borne singly. Even under such circumstances, however, a prolonged search will usually bring to view an occasional pair of the characteristic marginal hairs.

Marginal gemmae occur abundantly on some of the plants collected by Neger but are apparently absent from all the other specimens. The gemmiparous branches are essentially like the others and present no evidence of limitation in growth. The gemmae are usually scattered, although a crowded series is sometimes to be observed, and the mother-cells of the gemmae arise directly from the marginal cells, just as in *M. furcata* (**4**, p. 277). At the time of separation the gemmae vary considerably in size, average examples measuring perhaps 0.3–0.4 mm. in length and 0.15–0.2 mm. in width. Most of them are oblong in form, six to eight cells across, and show an indistinct stalk and a single apical cell. Crowded rudiments of marginal hairs, slightly displaced to one surface, are usually present and not infrequently show a paired arrangement. Otherwise the gemmae are scarcely differentiated. In germination (FIG. 4, B–D) the young plant is at first nothing more than a slightly narrower extension of the gemma, although in one somewhat older example a rudimentary costa was present with a wing three cells wide on each side. No late stages of germination have been observed.

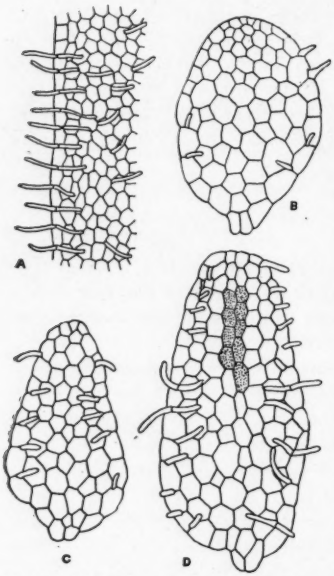

FIG. 4. METZGERIA DIVARICATA Evans.

A. Marginal portion of a thallus-wing, ventral view, × 50. B–D. Germinating gemmae, × 100. A was drawn from the type material; B–D, from a specimen collected in Chile by Neger, No. 68.

The list of specimens cited brings out the fact that *M. divaricata*, apparently on account of its variability, has been confused with three other species of *Metzgeria*. In the structure of the costa with its two rows of dorsal and four rows of ventral cortical cells it agrees with *M. conjugata* and *M. furcata;* in having ventral hairs, sometimes produced in considerable abundance, it agrees with *M. corralensis*. It is, however, amply distinct from all three species. It differs from *M. conjugata* in being dioicous and in having gemmae

and ventral alar hairs, while it differs from *M. furcata* in having paired marginal hairs. When strongly pubescent it resembles *M. corralensis* rather markedly but is distinguished by the more definite structure of the costa, by the occurrence of the marginal hairs in divaricate pairs, and by the marginal gemmae.

5. Metzgeria patagonica Steph.

Metzgeria patagonica Steph. Bull. Herb. Boissier **7**: 940. 1899.

Specimens examined: Newton Island, May, 1896, *Dusén 24* (M., U., Type).

The following additional station may be cited from the literature: Escapada Island, Skyring, *Skottsberg* (**24**, p. 11).

According to the original description of this well-marked species the wings of the thallus are strongly decurved and often revolute, but a supplementary note adds that the specimens are "etiolated" and that the normal structure is to be found only on the younger "innovations." In the material studied by the writer most of the thalli are perfectly plane and only a few of the branches show revolute margins. At the same time the plane thalli can hardly be regarded as abnormal; they do not present the appearance of being etiolated, and the presence of female branches in some abundance shows that the plants are by no means in a juvenile stage of development. The soluble yellow substance, to which Stephani calls attention in a later paper (**20**, p. 20), is very much in evidence when the specimens are soaked in water.

The thalli of *M. patagonica* are pale green, often deeply tinged with yellow, and grow in depressed mats. The width is mostly 1–1.5 mm. and the length may be as much as 3 cm. Measured in cells the wings are usually fifteen to twenty-five cells across. Although ventral branching sometimes occurs, dichotomous branching is far more common, the successive forks being mostly 1–5 mm. part.

Hairs are rarely abundant and many regions are nearly or quite free from them. The marginal hairs are straight and seem to be invariably borne singly. They are usually slightly displaced to the ventral surface, tending to extend at right angles to the wings, but they may be truly marginal and lie in the same plane as the wings. The hairs are about 10 μ in diameter and rather short, the length being usually only 0.1–0.12 mm. Although the wings are naked the costa sometimes bears loose and scattered clusters of hairs, essentially like the marginal hairs but sometimes a trifle longer. Apparently in either

position a hair has the power of branching at the tip and acting as an organ of attachment.

The costa shows the same structure as that of *M. divaricata*, being bounded dorsally by two rows of cortical cells and below by four. The alar cells, according to Stephani, measure 54 × 40 μ, those near the costa being 72 × 40 μ. The writer's measurements give an average of 41 × 33 μ and do not indicate that the cells near the costa are appreciably longer than the others. The cells throughout have rather firm walls, which often show nodular intermediate thickenings as Stephani notes, but the thickened angles that he likewise emphasizes are difficult to demonstrate.

No male branches have been seen by the writer and the original description does not mention them. Female branches are often abundantly produced, and it is a noteworthy fact that a female thallus sometimes becomes gemmiparous shortly after it has borne the sexual branches. Some of the latter are small and undeveloped, but most of them are of fair size (FIG. 5, A), measuring perhaps 0.5–0.7 mm. in length and 0.9–1 mm. in width. The outline, which is broadly orbicular with a deep apical indentation, does not show clearly without spreading the branches out flat, owing to their strong concavity. The margin shows crowded hairs borne singly, each representing the outgrowth of a small cell situated between two larger cells, just as in the normal vegetative thalli of most *Metzgeriae*. On the ventral surface the thickened median portion bears a dense cluster of hairs, and a few other hairs are scattered over the unistratose portion.

Mention has just been made of gemmiparous plants, although Stephani does not allude to them. As a matter of fact the gemmae of *M. patagonica*, which are marginal in position, yield some of the most distinctive characters of the species. The gemmiparous branches are at first scarcely modified but rapidly decrease in width after the formation of the gemmae has been initiated. When the wings have been reduced to a width of four or five cells the growth of the branch comes to an end. The reduction in the width of the wings is often accompanied by a simplification in the structure of the costa, the rows of ventral cortical cells being only two or three. In the formation of the gemmae their mother-cells are derived directly from the marginal cells of the branch, without a preliminary cell-division. The gemmae may be scattered or crowded, a long series of adjoining marginal cells sometimes giving rise to a continuous row of gemmae. The latter tend to appear in acropetal succession and yet show many exceptions to this arrangement.

At the time of separation the gemmae are flat and unistratose structures, orbicular to oblong in outline, broadening out abruptly from a two-celled and often indistinct stalk, and showing a broad and rounded apex with a single apical cell. They are mostly 0.25–0.3 mm. long and 0.18–0.25 mm. wide, being composed of six to eight indefinite rows of cells. On each side six to eight hairs are usually present, and these are commonly (but not invariably) arranged in pairs. The hairs extend almost at right angles to the surface of the gemma and, when paired, spread in opposite directions. The majority are strongly

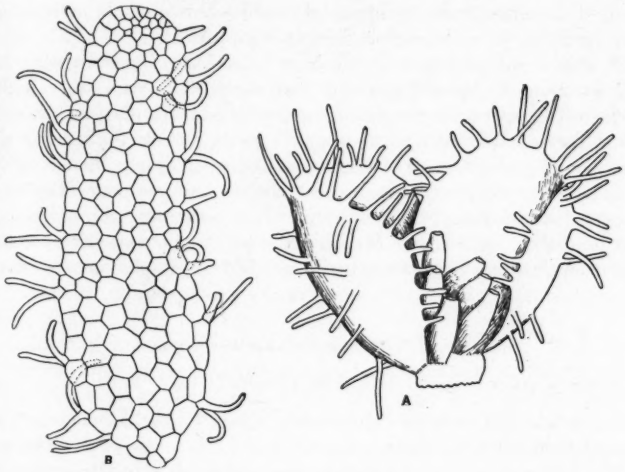

FIG. 5. METZGERIA PATAGONICA Steph.

A. Female branch, × 50. B. Germinating gemma, × 100. The figures were both drawn from the type material.

curved and might often be described as hamate. Only the earliest stages of germination have been observed and in these the young plants have simply repeated the features of the gemmae, except that they have sometimes been a little narrower (FIG. 5, B). In other words they have remained flat and unistratose thalli, showing no signs of dorsiventrality and tending to produce a succession of paired and divergent marginal hairs.

Marginal gemmae with hooked hairs have been described in *M.*

uncigera Evans of the West Indies and Florida (**4**, p. 273), a species in which the vegetative thallus bears straight hairs arising singly. Dorsal gemmae with hooked hairs have been described in two West Indian species, *M. dichotoma* and *M. vivipara* Evans (**4**, pp. 285, 288), in both of which the vegetative thallus bears straight marginal hairs, again arising singly. In *M. vivipara* twinned hairs occur as a rare exception, the hairs being usually borne singly; in the other two species twinned hairs are apparently never found. *M. patagonica* shows a new combination of characters — marginal gemmae with curved or hooked hairs arising in pairs and a vegetative thallus with straight marginal hairs arising singly. It is this unusual association that separates the species most sharply from its allies.

Of course the structure of the costa allies *M. patagonica* with *M. conjugata* and *M. furcata*, as well as with the preceding species. In *M. conjugata*, however, no gemmae are produced and the marginal hairs of the thallus are normally borne in pairs; in *M. furcata* the hairs of the gemmae, if present at all, are straight and arise singly; while in *M. divaricata* the marginal hairs of both thallus and gemmae often arise in pairs but are straight. Aside from these differences *M. patagonica* can be distinguished from *M. conjugata* by its dioicous inflorescence and from the other two species by its lack of ventral hairs on the wings.

6. METZGERIA CHILENSIS Steph.

Metzgeria chilensis Steph. Bull. Herb. Boissier **7**: 937. 1899.

SPECIMENS EXAMINED: Quiriquina Island, near Concepcion, no date, *Dusén 179* (M., TYPE).

The following additional stations may be cited from the literature: Clarence Island, *Racovitza* (**22**, p. 4); Quicavi, Chiloé, *Skottsberg* (**24**, p. 10); Juan Fernandez, *Skottsberg* (**24**, p. 10); New Zealand, *Colenso* (**19**, p. 937). The Juan Fernandez specimen is clearly distinct from the true *M. chilensis;* the other specimens have not been seen by the writer.

The species was based on two specimens, one from Chile and the other from New Zealand. The Chilean specimen is naturally to be regarded as the type, but the original description was probably partly drawn from the New Zealand specimen, since it does not agree in all respects with Dusén's material.

The plants in the Mitten Herbarium are very fragmentary and grew in a loose depressed mat in admixture with other bryophytes. The

thallus is mostly 0.5–0.9 mm. wide and attains a length of 1–1.5 cm. The wings, although described as almost revolute by Stephani, are flat or even slightly concave and are mostly six to twelve cells wide. The normal branching is dichotomous with the forks 2–10 mm. apart, but ventral branching is not exceptional.

The marginal hairs vary greatly in abundance. In some places they may be absent altogether; in other places, even on the same thallus, they may be as numerous as the marginal cells, a single hair arising between every two cells. In most cases the hairs are slightly displaced to the ventral surface, but they may be truly marginal, and it is not unusual for the apex to be branched and to act as an organ of attachment. The longest hair seen was 0.3 mm. long but most of them were 0.1 mm. or less in length, the average diameter being about 10 μ. The ventral surface of the wings is apparently wholly free from hairs, but the costa bears them in loose clusters or scattered and is rarely free from hairs for any great distance. These costal hairs are essentially like the marginal hairs but tend to be a little longer.

The costa is bounded both dorsally and ventrally by two rows of cortical cells, a type of structure found also in all the following species. The alar cells average about 35 $\times$ 27 μ, although Stephani's measurements gave 54 $\times$ 36 μ. The walls are slightly thickened and sometimes show minute trigones and occasional nodular intermediate thickenings.

According to Stephani the inflorescence is dioicous. The type specimen, however, is clearly autoicous, the male and female branches often occurring in close proximity. The male branches are mostly 0.3–0.4 mm. long and 0.25–0.3 mm. wide and are ellipsoidal in form, the margins being involute and the costa so strongly incurved that it approaches the base without reaching it. Except for the slime-papillae the surface is smooth. The female branches, which are more or less concave and obcordate in outline, are mostly 0.4–0.45 mm. long and 0.45–0.6 mm. wide. The marginal hairs grow out from small cells but are not numerous; the ventral hairs may be restricted to a cluster of six to twelve on the thickened median portion, but one to three scattered hairs may be present also on the wings. No gemmae have been observed.

The autoicous inflorescence will at once distinguish *M. chilensis* from all the other Chilean species. It agrees in this unusual feature with *M. conjugata*, but in that species the ventral cortical cells of the costa are in four rows and the marginal hairs often in pairs. The only other South American species to which an autoicous inflorescence has been

assigned is *M. albinea* Spruce, which further agrees with *M. chilensis* in the structure of the costa. In *M. albinea*, however, the marginal hairs are in pairs. Aside from the inflorescence *M. chilensis* approaches the following species very closely.

7. METZGERIA DECIPIENS (Massal.) Schiffn. & Gottsche.

Metzgeria furcata β. decipiens Massal. Nuovo Gior. Bot. Ital. **17**: 256. *pl. 28, f. 36.* 1885.
Metzgeria decipiens Schiffn. & Gottsche in Schiffner, Forschungsreise "Gazelle" **4**[4]: 43. 1890.
Metzgeria glaberrima Steph. Bull. Herb. Boissier **7**: 939. 1899.
Metzgeria nuda Steph. Kungl. Svenska Vet.-Akad. Handl. **46**[9]: 10. *f. 3a.* 1911.

SPECIMENS EXAMINED: Valdivia, 1887, *Hahn* (S.); Corral, 1905–06, *Thaxter 1f, 2c, 78, 110, 122, 124, 138, 141* (H., Y.); valley of the Aysen River, 1897, *Dusén 283* (Möll., as *M. glaberrima*, and listed under this name by Stephani, **20**, p. 20); Puerto Chacabuco, 1908, *Halle 256* (St., as *M. glaberrima*, and listed under this name by Stephani, **24**, p. 10); near the mouth of the Rio Pudeto, Chiloé, 1908, *Halle 256* (St., as *M. glaberrima*, and listed under this name by Stephani, **24** p. 10); Guaitecas Islands, 1897, *Dusén 394* (M., Möll., St., as *M. glaberrima*, and listed under this name by Stephani, **20**, p. 20); Port Gallant, Straits of Magellan, 1896, *Dusén* (N. Y., St., as *M. glaberrima*); Tuesday Bay, Straits of Magellan, 1876, *Naumann* (S., Y., listed by Schiffner, **16**, p. 43); Grappler Bay, Straits of Magellan, 1893, *Douglas* (H., Y.); Rio Azopardo, Tierra del Fuego, 1896, *Dusén 71* (U., as *M. glaberrima*, and listed under this name by Stephani, **21**, p. 10); Rio Olivia, Tierra del Fuego, 1902, *Skottsberg* (St., as *M. glaberrima*, and listed under this name by Stephani, **23**, p. 9); Cape Horn and Hermite Island, *Hooker* (M., as *M. furcata*, and listed under this name by Hooker and Taylor, **8**, p. 480); near Basil Hall, Staten Island, 1882, *Spegazzini* (Massal., Y., TYPE of *M. furcata β. decipiens*). The following three specimens from the Falkland Islands have likewise been examined: Port Stanley, 1902, *Skottsberg* (St., as *M. glaberrima*, and listed under this name by Stephani, **23**, p. 9); same locality, 1905, *Thaxter* (H., Y.); near Port Stanley, 1907, *Skottsberg 356* (U., type of *M. nuda*).

The following additional stations from the literature may be cited: Wellington and Desolation Islands, *Savatier;* and Hoste Island, *Hyades* (**2**, p. 246, as *M. furcata* var. *β. decipiens*).

The following stations for *M. glaberrima* may likewise be cited:

near Puerto Varas, *Dusén* (**20**, p. 20); Skyring and Dawson Island, *Skottsberg* (**24**, p. 10); Desolation Island, *Dusén* (**21**, p. 10); Ushuaia, Tierra del Fuego, *Skottsberg* (**23**, p. 9). Also the following stations beyond the boundaries of Chile: New Zealand and Australia, several collectors (**19**, p. 939); Antipodes Islands (**24**, p. 10).

As here understood *M. decipiens* is probably the commonest and most widely distributed *Metzgeria* in Chile. It exhibits a great deal of variation in size and particularly in width, in the number and distribution of its hairs and in the measurements of its alar cells. It shows, however, the following apparently constant features; a flat or slightly convex thallus; a costa bounded both dorsally and ventrally by two rows of cortical cells; a lack of ventral alar hairs; and a lack of gemmae. Another feature almost as constant is the presence of ventral vegetative branches. It is of course difficult to establish the absolute constancy of any characters in so variable a genus as *Metzgeria*, especially characters of a negative nature, but the writer has found no exceptions to the four first enumerated after a detailed study of the numerous specimens cited.

The plants are pale yellowish green and are sometimes scattered but usually form depressed and layered mats of considerable extent. They are frequently found on trees but are by no means restricted to such localities; in rare instances, in fact, they are epiphyllous in habit. The living portion of a thallus is usually 1–2 cm. long, while the width is mostly 0.8–1.2 mm. These figures represent the mean averages obtained from six specimens. The narrowest thallus seen, however, was only 0.2 mm. wide, while the widest was 1.8 mm. Measured in cells an average wing is usually thirteen to seventeen cells across; a very narrow wing, however, may be as little as two cells and a very wide one as much as twenty-seven cells. The ventral branches are sometimes so abundant that they largely replace the normal branches. When the latter occur to the usual extent the successive dichotomies are mostly 1–3 mm. apart. A ventral branch broadens out abruptly from a narrow stalk-like base and quickly acquires a normal width, often in fact just beyond the margin of the higher axis. Sometimes the branch spreads widely or obliquely; sometimes it grows in the same direction as the higher axis. Under the latter circumstances the axis is usually soon limited in growth; and, if the process is repeated, a more or less definite sympodium may be the result.

Hairs occur in two positions — along the margin and on the ventral surface of the costa. The marginal hairs (FIG. 6, A) are by far the more numerous and are sometimes very abundantly produced. In

other cases, however, a prolonged search is necessary before any hairs at all can be demonstrated, and there are many intermediate conditions between these extremes. A thallus, in fact, may produce hairs abundantly in one part and be hairless or nearly so in another. When the marginal hairs are crowded a single hair usually arises between every two marginal cells, but sometimes the hairs arise in pairs more or less frequently. When borne singly they are either truly marginal or slightly displaced to the ventral surface. The hairs are usually straight and measure 0.15–0.3 mm. in length by 10–12 μ in width. In rare instances they are branched at the apex and act as organs of attachment. Costal hairs are usually exceedingly rare, and in many individual thalli none at all can be demonstrated, as Stephani notes under *M. glaberrima*. When they occur they are either scattered or in small irregular clusters and are essentially like the marginal hairs.

The alar cells vary considerably in size (Fig. 6, A–D), not only in different thalli but also (in some cases at least) in different parts of the same thallus. In Spegazzini's material from Staten Island, for example, the cells in most places averaged about 48 $\times$ 36 μ, while a branch of a thallus yielding these higher measurements in its other parts had cells averaging only 35 $\times$ 29 μ. Taking the mean averages of fourteen specimens the cells measure about 38 $\times$ 29 μ, the highest average being 48 $\times$ 26 μ and the lowest 31 $\times$ 22 μ. Stephani's measurements of *M. glaberrima*, 36 $\times$ 36 μ, agree closely with the general average. It must of course be remembered that individual alar cells may deviate rather widely from these average measurements. The cells have thin or slightly thickened walls, and trigones are either minute or absent altogether.

The male branches of *M. decipiens* present few distinctive features. They are almost globular in form, the wings being involute and the costa so strongly incurved that the apex almost reaches the base (Fig. 6, E). The largest example measured was about 0.35 mm. in diameter. Hairs are entirely absent, but the usual slime-papillae are of course present.

The female branches (Fig. 6, F–I) are broadly obovate and vary from plane to convex when viewed from the ventral surface. Exclusive of the hairs they are usually 0.3–0.4 mm. in length and 0.45–0.75 mm. in width. Along the margin the hairs are crowded but apparently never in pairs, each hair representing the outgrowth of an ordinary marginal cell. On the ventral surface the hairs, if developed at all, are restricted to the thickened median portion, where from one to perhaps twenty may be present, the number being usually larger if

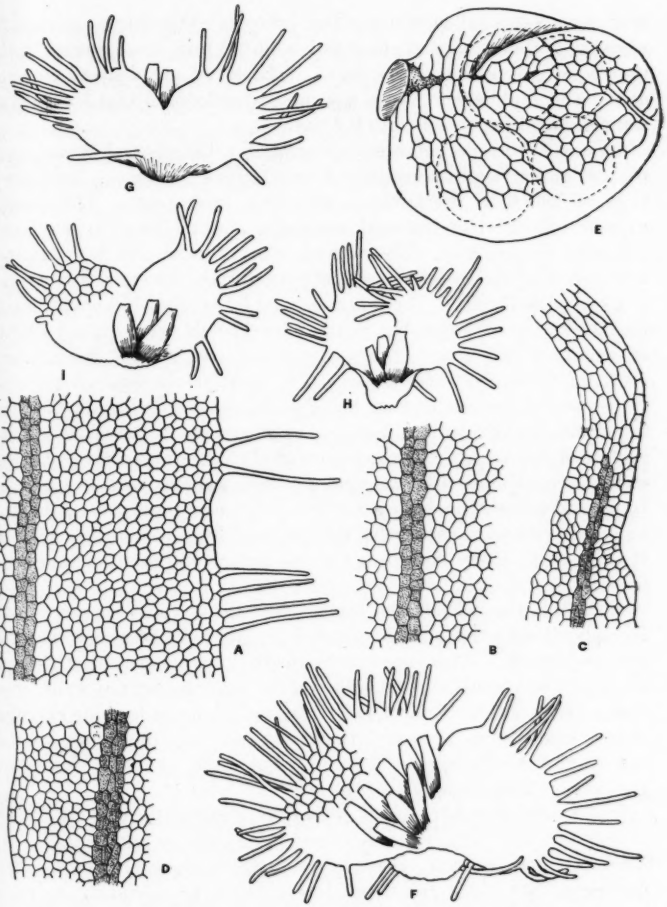

FIG. 6. METZGERIA DECIPIENS (Massal.) Schiffn. & Gottsche.

A–D. Portions of thalli, ventral view, × 50. E. Male branch, × 100. F–I. Female branches, × 100. A, F, and G were drawn from a specimen collected by Naumann at Tuesday Bay; B and H, from a specimen of *M. glaberrima* collected on the Guaitecas Islands by Dusén, No. 394; C, from a specimen of *M. glaberrima* collected on Tierra del Fuego by Dusén, No. 71; D, E and I, from a specimen collected at Corral by Thaxter, No. 78.

fertilization has taken place. The calyptra at maturity is clavate, measuring about 1.2 mm. in length and 0.6 mm. in diameter in the upper part, exclusive of the hairs. The latter are densely crowded above the middle and more sparingly developed toward the base; some of them attain a length 0.4 mm.

On one of the specimens from Corral, No. 138, several capsules are present and give an opportunity for describing the valves, our knowledge of which in *Metzgeria* is still very incomplete. The mature capsule is dark brown and oval, measuring about 0.6 mm. in length and 0.4 mm. in diameter. The valves, when spread out flat, measure 0.6×0.3 mm. and are composed, as is uniformly the case in *Metzgeria*, of two layers of cells. Those of the outer layer (FIG. 7, A) are more or less subject to variation but in the more typical cases extend lengthwise and are two or three times as long as broad, a valve being mostly fourteen to sixteen cells across. The local thickenings of the cell-walls are conspicuous and are largely (but not wholly) confined to the inner longitudinal walls, that is, to the walls turned toward the middle of the valve. The median wall thus shows two rows of thickenings, which alternate with one another, whereas each other longitudinal wall shows only one such row. As a rule three or four thickenings are present in each cell; they extend from the surface through the thickness of the layer but are not prolonged on either tangential wall.

Although the cells of the inner layer (FIG. 7, B) do not exactly correspond with those of the outer layer, they are of about the same size and shape. With rare exceptions each cell shows from three to six transverse bands of thickening on the inner tangential walls, these bands being prolonged down the radial walls but not forming complete rings. Sometimes, however, the bands are less developed and do not extend wholly across the tangential walls, gradually fading out toward the outer boundary of the cell.

The spores are pale yellow, minutely punctulate, and 14–16 μ in diameter. The elaters are mostly 0.3–0.4 mm. in length and 6 μ in diameter in the middle, tapering gradually to the extremities. Each one bears the usual broad band of thickening extending its entire length.

If the account of the capsule-valves as given above is compared with the description of Andreas (**1**, p. 195) certain interesting differences become apparent. According to his statements the three rows of cells of the outer layer that come next to the edge of the valve have their thickenings definitely restricted to the inner longitudinal walls.

In the remaining cells, however, the thickenings are arranged more irregularly and the median wall of each valve is entirely free from them. In all probability these differences are specific in character, and it is natural to assume that the capsule-valves in *Metzgeria* may be as useful in distinguishing closely related species as in the related genus *Riccardia*. It is to be regretted that Andreas does not indicate the species from which his description was drawn.

Although no gemmae have been observed in *M. decipiens*, a single case of regeneration from a marginal cell has been demonstrated. The product of regeneration in this instance bore a strong resemblance to a gemma, but its true nature was made evident by the zone of dead cells separating it from the rest of the thallus. Attention may be called also to the ease with which the species reverts to a more juvenile condition. The narrow and relatively hairless thalli, which have been described, represent cases of such reversion, and these often reach a more extreme state by losing their costae altogether, thus becoming reduced to uniform, unistratose bands of cells (FIG. 6, C). The prevalence and long duration of these reversionary forms have added to the difficulties of recognizing and defining the species.

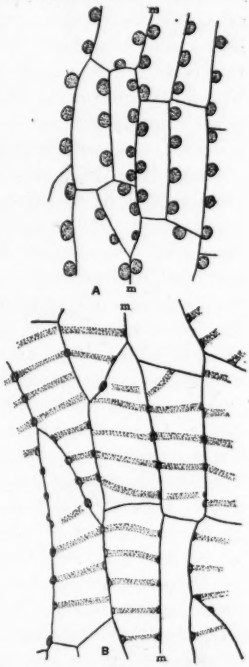

FIG. 7. METZGERIA DECIPIENS (Massal.) Schiffn. & Gottsche.

A. Cells from outer layer of a capsule-valve, × 300; *m*, median wall of valve. B. Cells from the inner layer of a capsule-valve, × 300; *m*, median wall of valve. The figures were both drawn from a specimen collected at Corral by Thaxter, No. 138.

In reducing *M. decipiens* to doubtful synonymy under *M. nitida* (see p. 272) Stephani criticised Schiffner for basing a new species on material so poorly developed that it could not be definitely determined. In the writer's opinion this criticism is unjustified. In the first place *M. decipiens* was really based on *M. furcata* var. *decipiens* of Massalongo, and the figures drawn from Spegazzini's type specimen (**11**, *pl. 28, f. 36*)

show female branches in abundance, some of them with young calyptras. Massalongo's description, moreover, in spite of its brevity, brings out some of the most distinctive characters of the species. In the second place Naumann's "Gazelle" Expedition specimen of *M. decipiens* is equally well developed and also shows characteristic female branches. It even illustrates the variability of the species to a certain extent, some of the thalli being almost destitute of hairs. These two specimens, which the writer has carefully examined, agree in all essential respects and certainly form an adequate basis for the proposal of a new species.

Under the original description of *M. glaberrima*, which is here included among the synonyms of *M. decipiens*, Stephani cited specimens from the Straits of Magellan, "Chile," New Zealand and Australia. Apparently he afterwards changed his mind regarding the New Zealand and Australian material, for, in 1911, he restricted the range of the species to southern Chile, Tierra del Fuego, Falkland and Antipodes Islands (**24**, p. 10). The natural inference from this would be that *M. glaberrima* as originally defined was an aggregate. If this should be established the "type-specimen" should presumably be one of those from the Straits of Magellan, since these are mentioned first. As collectors of the Magellan specimens Stephani named Spegazzini, Dusén and the "Exped. Gazelle." The actual specimens of Spegazzini and Naumann cited have not been seen by the writer. Dusén's Port Gallant specimen, however, agrees fully with Spegazzini's specimen of *M. furcata* var. *decipiens* and Naumann's specimen of *M. decipiens;* and, since it agrees with none of the other specimens of *Metzgeria* collected by Spegazzini and Naumann, it would almost seem as if Stephani had based his *M. glaberrima*, at least in part, upon the very specimens utilized by Schiffner in his description of *M. decipiens*. In any case Dusén's Port Gallant specimen is referable to *M. decipiens*, and the same thing is true of at least two other specimens collected by Dusén and definitely listed by Stephani under the name *M. glaberrima*. It therefore seems justifiable to consider the latter a synonym of *M. decipiens*, even if the original *M. glaberrima* included other distinct forms. The writer regrets that the New Zealand and Australian specimens cited by Stephani have not been available for study.

The type specimen of *M. nuda*, likewise included as a synonym, is sterile and far more poorly developed than the original material of *M. decipiens*. The thalli are not invariably naked, as the description states, although the hairs even when present are scantily developed. They occur on the margin and also ventrally on the costa. The alar

cells average about 33 × 21 μ but are not always as small as this, averaging in one area as much as 41 × 33 μ. Since the absence of cilia is the only important feature distinguishing *M. nuda* from *M. decipiens*, and since this feature has been proved inconstant, the two species are clearly synonymous.

8. **Metzgeria epiphylla**, sp. nov.

Yellowish or whitish green, not becoming bluish after drying, scattered or in thin depressed mats, loosely adherent to the substratum: thallus prostrate, repeatedly dichotomous but also with ventral vegetative branches, flat or slightly convex, well-developed thalli mostly 0.6–0.8 mm. wide and rarely as much as 1 mm., the forks mostly 0.6–2.4 mm. apart; costa bounded both dorsally and ventrally by two rows of cortical cells; wings mostly eight to thirteen cells broad, the cells mostly 37 × 30 μ, the walls thin or slightly and uniformly thickened, sometimes with indistinct trigones; hairs varying in abundance; marginal hairs usually occurring singly but not infrequently in pairs, sometimes branched at the apex and acting as rhizoids, mostly 0.1–0.15 mm. long and 8–10 μ wide; ventral hairs sometimes lacking, sometimes sparingly developed on the costa and still more sparingly on the wings, similar to the marginal hairs: inflorescence dioicous: ♂ branches subspherical, smooth, 0.3–0.4 mm. long and 0.25–0.35 mm. wide: ♀ branch broadly obovate, 0.3–0.35 mm. long and wide, hairs abundant on the margin and usually on the ventral surface; calyptra about 1 mm. long and 0.45 mm. wide, the hairs abundant above the middle, few and scattered below: capsule brown, oval, mostly 0.5–0.6 mm. long and 0.35–0.4 mm. wide, the valves (when spread out) 0.6–0.75 × 0.2–0.25 mm.; spores pale brownish yellow and very minutely punctulate, 16–18 μ in diameter; elaters 0.3–0.4 mm. long, 6 μ wide in the middle and with a single broad spiral band running the entire length: gemmae sometimes abundant, arising on more or less narrowed and specialized branches with limited growth, marginal or submarginal and dorsal in position, orbicular to oval, plane or slightly convex and bearing a few short marginal hairs slightly displaced to the concave surface.

SPECIMENS EXAMINED: Corral, 1896, *Dusén 82, 191* (U., as *M. australis*, and listed under this name by Stephani, **20**, p. 19); same locality, 1905–06, *Thaxter 10a, 108, 140* (H., Y.). No. 10a, collected by Professor Roland Thaxter, may be designated the type.

In its vegetative features *M. epiphylla* resembles *M. decipiens* so

closely that it would be difficult to tell them apart if these features alone were relied upon. Both species, for example, show a flat or nearly flat thallus, branching both dichotomously and ventrally, and having a costa bounded on each surface by two rows of cortical cells. The costae, moreover, although usually naked, occasionally develop a few ventral hairs; the alar cells are almost identical in size and in the characters derived from their walls; and the marginal hairs exhibit a similar range in abundance, being sometimes numerous and sometimes very few and occasionally showing a twinned arrangement although usually occurring singly.

On the whole *M. epiphylla* (FIG. 8, A) is slightly smaller than *M. decipiens* and prefers living leaves as a habitat, although it occasionally grows on bark. *M. decipiens*, on the contrary, is much more at home on bark and other substrata than on leaves. One other vegetative difference to be noted, although more observations are necessary to prove its constancy, is the occasional presence of ventral alar hairs in *M. epiphylla* and their complete absence in *M. decipiens*.

The most trustworthy differential characters, however, are those derived from the sexual branches and the capsules, and these are supplemented by the presence of gemmae in *M. epiphylla* and their absence in *M. decipiens*. The male branches are much alike in the two species, except that those of *M. epiphylla* are even more strongly incurved, so much so that the apex usually comes in contact with the base. The female branches when normally developed are distinguished by their greater hairiness, the ventral hairs not being restricted to the thickened median portion, as in *M. decipiens*, but scattered over the entire surface. The capsules are mainly distinguished by differences in the character and distribution of the local wall-thickenings of the valves. In *M. decipiens*, as has been shown, the median wall of the outer layer has two rows of local thickenings, these being largely restricted to the inner longitudinal walls of the valve-cells. In *M. epiphylla* the median wall has no local thickenings or very small ones (FIG. 8, B), approaching in this respect the condition described by Andreas. On each side of this median wall two rows (or more rarely three) have the thickenings restricted to the outer longitudinal walls, while the remaining cells have them on the inner walls, as in *M. decipiens*. Each valve thus has two longitudinal walls with double rows of local thickenings. In the inner layer of the valves, transverse bands, instead of being conspicuous, are either lacking or very indistinct (FIG. 8, C), although the prolongations of such bands on the radial walls are still apparent.

Even in the absence of sexual branches and capsules, the presence

of gemmae will at once serve to distinguish *M. epiphylla* from *M. decipiens*. The gemmiparous branches seem to be always narrower than the normal vegetative thalli, the reduction in width being confined to the wings, but at first no other signs of differentiation are evident. With the appearance of the gemmae (FIG. 8, D) the wings become still narrower and the branches curve away from the substratum, their growth in length being sooner or later brought to an end. In extreme

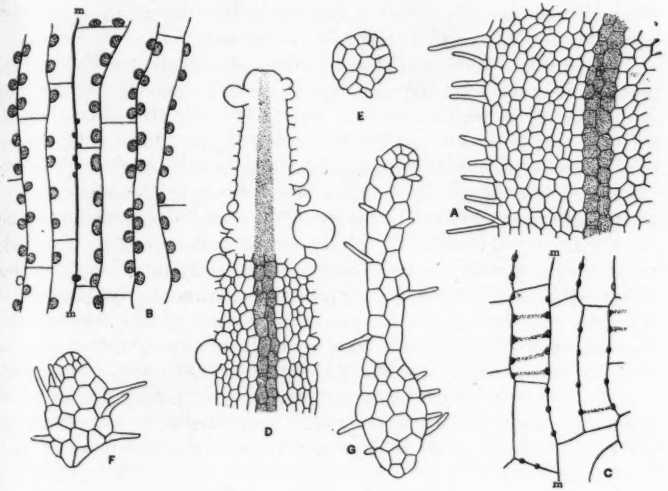

FIG. 8. METZGERIA EPIPHYLLA Evans.

A. Portion of a thallus, dorsal view, × 50. B. Cells from outer layer of a capsule-valve, × 300; *m*, median wall of valve. C. Cells from inner layer of a capsule-valve, × 300; *m*, median wall of valve. D. Gemmiparous branch, dorsal view, × 50. E, F. Gemmae about ready to separate, × 100. G. Germinating gemma, × 100. The figures were all drawn from the type material.

cases the wings become reduced to a width of only two or three cells, but the growth may cease while the wings are considerably broader. No cases have been observed where a gemmiparous branch had reverted to a vegetative condition, and yet it would not be surprising if such a change occasionally took place. The gemmiparous branches are flat or slightly convex when seen from the dorsal surface and sometimes branch after the production of gemmae has begun.

The gemmae which are first produced are strictly marginal, and in their development a marginal cell becomes directly the mother cell of the gemma. After the gemmae have been set free the empty mother cells with their ruptured outer walls can easily be demonstrated, and sometimes long and continuous stretches of such empty cells are present, indicating a copious formation of gemmae. Later on, with the narrowing of the gemmiparous branches, the cells of the submarginal row may in turn give rise to gemmae, setting them free dorsally. Apparently, however, the alar cells within this row and the cortical cells of the costa do not have this power.

The gemmae when set free are plane or slightly convex bodies, always small and relatively simple, yet varying somewhat in size and in the number of their component cells (FIG. 8, E, F). Most of them are orbicular to oval in outline, measuring 0.1–0.12 mm. in length by 0.09–0.1 mm. in width and being usually four cells across. A single apical cell is present and the stalk cells, although normally two, are often indistinct. On each side three or four short marginal hairs, borne singly and slightly displaced to the concave surface, can be detected; these are sometimes spreading and sometimes extend at right angles to the surface of the gemma. Upon germination the marginal hairs elongate, and the apical cell resumes its growth, giving rise to a flat thalloid extension only two or three cells wide and thus narrower than the gemma itself. In the case illustrated (FIG. 8, G) this extension had grown to more than twice the length of the gemma and had produced a series of scattered marginal hairs, slightly displaced to one surface. No later stages of germination have been observed.

9. METZGERIA VIOLACEA (Ach.) Dumort.

Jungermannia violacea Ach.; Weber & Mohr, Beitr. Naturk. **1**: 76. *pl. 1, f. 1–3.* 1805.
Fasciola violacea Dumort. Comm. Bot. 114. 1822 (in part).
Echinogyna violacea Dumort. Syll. Jung. 84. 1831 (in part).
Echinomitrium violaceum [*Echinomitrion violasceus*] Corda; Sturm, Deutschl. Flora **2**: 81. *pl. 22.* 1832 (in part).
Echinomitrium [*Echinomitrion*] *furcatum δ. violaceum* Hüben. Hep. Germ. 47. 1834 (in part).
Metzgeria violacea Dumort. Recueil d'Obs. sur les Jung. 26. 1835 (in part).
Metzgeria furcata δ. 2. violacea Nees, Naturg. Europ. Leberm. **3**: 489. 1838 (in part).
Metzgeria conjugata var. *β. violacea* Lindb. Acta Soc. F. et Fl. Fenn. **12**: 34. 1877.
Metzgeria angusta Steph. Bull. Herb. Boissier **7**: 944. 1899 (in part).
Metzgeria antarctica Steph. Sp. Hepat. **6**: 47. 1917.

SPECIMENS EXAMINED: near Arique, no date, *Lechler 633* (B., as *M. furcata* var. *violacea*, and listed as *M. furcata* by Stephani, **19**, p. 941); Corral, 1896, *Dusén*, mixed with *82* (U.); valley of the Aysen River, 1897, *Dusén 324* (Möll., St., as *M. hamata*, and listed under this name by Stephani, **20**, p. 20); Quellon, Chiloé, 1908, *Halle & Skottsberg 29* (St., as *M. chilensis*, and listed under this name by Stephani, **24**, p. 10); Punta Arenas, 1895, *Dusén 5* (U., as *Metzgeria* sp.); same locality and date, *Dusén*, no number (Möll., N. Y., as *M. angusta*, and listed under this name by Stephani, **21**, p. 10); same locality, 1905–06, *Thaxter 159* (H., Y.); same locality, 1907, *Von Schrenk* (B., type of *M. antarctica*); Isla di Navarino, Tierra del Fuego, 1902, *Skottsberg* (St.); Provenir, Tierra del Fuego, 1895, *Dusén 23* (U., as *M. angusta*, and listed under this name by Stephani, **21**, p. 10). The following specimens collected outside the boundaries of Chile may likewise be cited: without definite locality, Peru, *Lechler*, mixed with another species of *Metzgeria* (N. Y., as *M. furcata* var. *violacea*); San Carlos, Lake Nahuelhuapi, Argentina, 1897, *Dusén 456* (St., U., as *M. angusta*, and listed under this name by Stephani, **20**, p. 19); Dusky Bay, New Zealand, 1773, *Sparrmann* (Y., TYPE of *Jungermannia violacea*, specimen received from the Acharius Herbarium at Lund).

Specimens of *Metzgeria* showing a bluish or purplish coloration have long been familiar to students of the Hepaticae. As long ago as 1785 Dickson described the color of his *Riccia fruticulosa*, now known as *Metzgeria fruticulosa* (Dicks.) Evans (see **4**, p. 293), as "aeruginosus seu viridi-subcaeruleus," and Acharius, in 1805, stated that the present species had a "schöne Veilchenfarbe." The older writers evidently regarded these unusual hues as natural to the living plant, and Hübener, in 1834, associated the color with the presence of iron in the substratum (**9**, p. 47). A few years later, however, Funck showed that these ideas were untenable. In a letter addressed to Nees von Esenbeck (see **15**, p. 492) he discussed the blue color of *M. fruticulosa*, which he had found at Gefrees, in the Fichtel Mountains of Germany. His specimens grew on the young trunks of the Norway spruce and were distinctly green when he collected them. About six months after they were dried most of them had assumed a blue color. The soil where the trees grew was a disintegrated gneiss, without a trace of iron, and he suggested that there might be some connection between the color and the tannin in the bark. His opinion regarding the post mortem nature of the blue coloration has recently been confirmed by Miss Herzfelder (**7**, pp. 392–397), who worked mainly on *M. fruticu-*

losa. According to her statements no plants showing the blue or purple color are capable of revivication.

The coloration is by no means characteristic of the genus *Metzgeria* as a whole but is confined to certain definite species. It thus has a significance from the standpoint of taxonomy, even if lifeless specimens are the only ones that show it. So far as the writer's observations go the coloration is usually, if not invariably, associated with gemmiparous species and, in some cases at least, with species in which the gemmiparous branches show marked differentiation. The species may further be distinguished by a tendency toward reversion and by the long persistence of embryonic and juvenile stages of development. In extreme cases this persistence may be so pronounced that a large mat of plants will absolutely fail to show the normal features of the species to which it belongs. Most of the species in question are, moreover, usually sterile, and, even when male branches are present in some abundance, female branches are almost always extremely rare or absent altogether. On account of these various peculiarities the species of *Metzgeria* turning bluish or purplish have been the source of much confusion to students, and different observers have often reached divergent conclusions in regard to them.

The best known species in this category is *M. fruticulosa,* widely distributed in Europe and recently reported by the writer from the states of Washington and Oregon. *M. violacea* is a close relative of *M. fruticulosa,* so close that it can hardly be regarded as anything more than a "small" or "geographical" species. The original material of *Jungermannia violacea* was collected in 1773 at Dusky Bay, New Zealand, by A. Sparrmann, who accompanied Captain Cook on his second voyage. Strange to say there is no record of its having been collected there a second time, and most of the works dealing with the Hepaticae of New Zealand make no mention of it whatever. This is true, for example, of Hooker's well-known Handbook of the New Zealand Flora, published in 1867, and of Stephani's recent Species Hepaticarum.

The earlier writers, however, were more charitable toward the species. In 1815 its validity was recognized by Weber (**27**, p. 100), who regarded it as identical with Dickson's *Riccia fruticulosa,* reducing the latter to synonymy, in spite of its having been published earlier. For a while Weber's views prevailed to a certain extent, and European writers continued to use the name "*violacea,*" now in a specific and now in a varietal sense, always assuming as they did so that *J. violacea* and *Riccia fruticulosa* were one and the same thing. With the lapse

of time the names "*violacea*" and "*fruticulosa*," as applied to *Metzgeriae*, gradually fell into disuse, and the plants to which they were applied came to be regarded as unimportant forms of *M. furcata*. Lindberg, fortunately, did not share these views. He considered that *R. fruticulosa* represented a distinct and well-marked variety of *M. furcata* and that it was amply distinct from *J. violacea*, which he regarded as a corresponding variety of *M. conjugata*. It remained for the writer to restore Dickson's plant to specific rank, under the name *M. fruticulosa*, and the same recognition, with considerable hesitation, is given to *M. violacea* in the present paper.

Through the kindness of Professor Nordstedt of Lund, the writer has had the privilege of studying a part of the type material of *Jungermannia violacea*. In spite of its long preservation it soaks up readily in water and retains the vivid coloration to which it owes its name. It lacks sexual organs completely, as the published descriptions emphasize, but shows pointed and highly differentiated gemmiparous branches, to which numerous gemmae still remain attached. These specimens have been carefully compared with the long series of Chilean specimens listed above and do not seem to differ from them in any important respect. *M. violacea*, as here understood, is exceedingly variable; it shows marked reversions, and many of the plants examined exhibit a juvenile or even embryonic stage of development. The following account is therefore somewhat composite in character.

The more typical vegetative thalli vary from flat to convex, with the margins of the wings more or less revolute. The width is usually 0.5–0.8 mm., but narrower thalli are not infrequent and some attain a width of 1 mm. or slightly more. Measured in cells the wings are mostly ten to twenty cells wide. Ventral branching occasionally occurs, although the usual method is by forking, the forks being mostly 0.6–1 mm. apart and the entire thallus rarely exceeding a length of 0.5–1 cm. The alar cells, taking the mean average from five specimens, measure about $31 \times 25\ \mu$, the highest average obtained being $34 \times 27\ \mu$ and the lowest $27 \times 21\ \mu$. The walls are thin throughout and trigones are either absent altogether or minute and inconspicuous.

The variation in the number and distribution of the hairs is about as great as in *M. decipiens* and *M. epiphylla*. In other words a thallus may be hairless throughout the whole or the greater part of its extent, it may produce hairs in abundance, or it may present almost any intermediate condition between these extremes. The marginal hairs are not infrequently in pairs but usually arise singly. In fact, on some of the plants examined no twinned hairs could be discovered, although

the hairs were fairly numerous. When the wings are distinctly revolute and the hairs abundant, a delicate weft is sometimes to be observed between the contiguous margins, much as in *M. decrescens*, but the hairs are just as likely to extend irregularly in all directions. Even when marginal hairs are present the thallus is often naked elsewhere; in other cases ventral hairs can be demonstrated on the costa and, still more rarely, on the wings. The hairs vary greatly in length, the majority measuring perhaps 0.08–0.12 μ in length; the diameter is mostly 10–12 μ. The costa, in ordinary well-developed thalli, is bounded both dorsally and ventrally by two rows of cortical cells.

In two specimens a few male branches were observed. They were smooth and almost spherical, the costa being so strongly incurved that the apex almost touched the base. Some of the branches were about 0.25 mm. in diameter but a few were somewhat larger, the largest one seen measuring 0.4–0.35 mm. The single female branch demonstrated was so disintegrated that its true features could not be determined. It bore a young calyptra with crowded hairs in the upper part and scattered hairs below the middle.

In most of the material gemmae are present in large numbers, and the gemmiparous branches (FIG. 9, A, B) show interesting modifications, comparable with those described under *M. epiphylla* but reaching a more advanced type of specialization and approaching in this respect the highly specialized gemmiparous branches of *M. fruticulosa*. Even when the vegetative branches are strongly convex and prostrate the gemmiparous branches are plane or nearly so and curve away from the substratum. At the same time the wings become narrower and narrower until, in extreme cases, they become reduced to a width of only two or three cells. No cases have been noted, however, in which the wings had entirely disappeared, and the growth of the gemmiparous branch often comes to an end while the wings are still four cells broad or more. With the reduction in the width of the wings, the cortical cells sometimes continue to show the usual arrangement in four rows, but the rows sometimes become increased to as many as six, both dorsally and ventrally, the rows under these circumstances being irregular and the cells themselves considerably reduced in size. Sometimes, especially when the formation of gemmae begins in a juvenile thallus, the gemmiparous branches may lose their costae and become reduced to narrow unistratose thalli only five or six cells broad; or, if the vegetative thallus itself lacks a costa, the gemmiparous branches may retain the same simple structure throughout their entire length. In other cases the gemmiparous branches may

develop new costae (FIG. 9, A), sometimes retaining them as long as growth continues and sometimes losing them before growth is brought to an end. It will be seen from this account that the gemmiparous branches exhibit a wide range of variability.

The first gemmae to be produced are marginal and arise in acropetal succession, every marginal cell in extreme cases giving rise to a gemma. If the gemmiparous branch shows the more specialized features described above, some of the later gemmae may be given off dorsally from the submarginal alar cells and perhaps also from the cortical cells of the costa both dorsally and ventrally, the acropetal succession in such cases not persisting. In instances of extreme production the crowded gemmae extending in all directions almost conceal the tip of the slender gemmiparous branch, although even then the apical cell of the branch can usually be clearly distinguished.

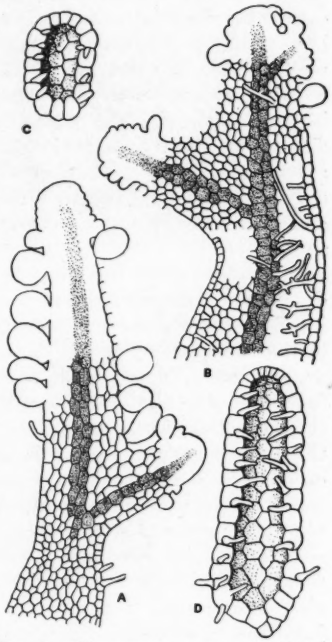

FIG. 9. METZGERIA VIOLACEA (Ach.) Dumort.

A, B. Gemmiparous branches, ventral view, × 50. C. Gemma about ready to separate, × 100. D. Germinating gemma, × 100. A was drawn from an unnumbered specimen labelled *M. angusta* and collected at Punta Arenas by Dusén; B–D, from a specimen collected at the same locality by Thaxter, No. 159.

At the time of separation the gemmae vary considerably in size, but an average example measures about 0.12–0.1 mm. and is five cells across. It is oblong in outline and strongly convex, the whole margin (including the single apical cell and the indistinct stalk) being revolute (FIG. 9, C). On each side three or four short rudiments of marginal hairs can be distinguished; these normally arise between every two marginal cells and may be borne singly or (more rarely) in pairs. Otherwise the gemmae show no cell-differentiation and are unistratose throughout.

In the early stages of germination the young plant simply repeats the features of the gemma and develops into a narrow strap-shaped thallus, strongly convex and bearing single or twinned hairs between every two marginal cells (FIG. 9, D). As the growth goes on the hairs of the gemma elongate and tend to equal those of the young plant. Even this early stage may be long-continued, and repeated dichotomies may take place before signs of further differentiation become apparent. The plant may, in fact, become gemmiparous almost immediately, and, in extreme cases, a gemma may form secondary gemmae before becoming detached. If differentiation proceeds normally the young plant gradually grows wider, develops a costa, and eventually shows the characteristic vegetative features of the species.

If the description just given is compared with the writer's earlier description of the gemmae and gemmiparous branches in *M. fruticulosa*, it will be seen that they correspond in most essential respects, and even in their vegetative features the two species are strikingly alike. In *M. fruticulosa*, however, the costa rather frequently shows three or four rows of ventral cortical cells, the gemmiparous branches sometimes lose their wings completely (becoming radial in character), and the gemmae are either plane or only slightly convex. In *M. violacea*, on the other hand, the costa of a vegetative thallus rarely shows more than two rows of ventral cortical cells (except just behind a dichotomy), the gemmiparous branches apparently never lose their wings completely (thus remaining dorsiventral), and the gemmae are distinctly convex. On the basis of these slight differences and the wide geographical separation of *M. fruticulosa* and *M. violacea*, it seems justifiable to admit the validity of both, at least provisionally.

Among the Chilean species *M. violacea* finds its closest allies in *M. decipiens*, which never produces gemmae, and *M. epiphylla*, which produces marginal and submarginal gemmae on specialized branches. The latter species is especially close, and the characters derived from the costa, the alar cells and the hairs are almost identical, except that the cell-measurements are a trifle higher. The following differential characters, however, suffice to distinguish the species under most circumstances. In *M. violacea* the plants usually grow on wood and develop a bluish coloration after being dried; the thallus is frequently convex; the gemmiparous branches reach a high stage of specialization, giving off gemmae from the cortical cells of the costa as well as from the alar cells; and the gemmae themselves are distinctly convex. In *M. epiphylla* the plants usually grow on leaves and do not develop a

bluish coloration after being dried; the thallus is rarely distinctly convex; the gemmiparous branches, although specialized, develop gemmae only from alar cells; and the gemmae themselves are plane or only slightly convex.

Stephani's *M. angusta*, to which he referred some of Dusén's specimens of *M. violacea*, was based on material from Brazil, Venezuela, Trinidad, Mexico, Guatemala, Louisiana and Santo Domingo, as well as from Chile and Patagonia. He speaks of Dusén's specimens as exceedingly reduced, so that in all probability they are distinct from the other specimens cited. According to the description of *M. angusta* the wings are everywhere eight cells wide, the alar cells measure 54 × 37 μ, and the costa is setulose throughout on the ventral surface. It will be seen that this description does not apply very well to the specimens of *M. violacea*. The description of *M. antarctica* applies much better, except that the wings are usually much narrower than 0.7 mm., the measurement there given. It is unfortunate that Stephani made no mention in his description of the gemmae and gemmiparous branches, which certainly yield the most distinctive characters of the species.

10. METZGERIA MAGELLANICA Schiffn. & Gottsche.

Metzgeria magellanica Schiffn. & Gottsche in Schiffner, Forschungsreise "Gazelle" **4**[1]: 43. *pl. 8, f. 6.* 1890.

SPECIMEN EXAMINED: Tuesday Bay, Straits of Magellan, 1876, *Naumann* (S., TYPE); known with certainty only from the type locality.

The type material of this interesting species, kindly sent for examination by Professor Schiffner, shows that it is amply distinct from *M. nitida*, under which Stephani included it as a synonym (see p. 272). The plants are a dull whitish green and grew in loose mats in admixture with other bryophytes, including a trace of *M. decipiens*. The thallus is normally so strongly convex that it approaches a terete condition, the revolute wings almost meeting below, as shown in the published figure. Of course, as would be expected, the convexity is sometimes less pronounced than this, and the thallus may even approximate a plane condition. The width when explanate is about 1 mm.; in the natural state it is usually 0.6–0.8 mm., and the length rarely exceeds 2 cm. Measured in cells the wings are mostly ten to eighteen cells across. Ventral branching is not rare, but the normal branching is dichotomous, the successive forks being usually 1–3 mm. apart.

Hairs vary somewhat in abundance and are apparently restricted to the margin, the ventral surface being entirely naked throughout. In many cases the margin is likewise hairless for long stretches, but at the other extreme the hairs may occur between every two marginal cells. They usually extend in the same direction as the wings, rarely being numerous enough to form a weft in the space between the margins. According to the original description the hairs often occur in pairs or even in three's. The writer, however, has been unable to verify this statement. So far as his observations go the hairs are invariably borne singly, arising in the usual way from small cells cut off from the marginal cells. In rare instances the marginal cells themselves may project directly as hairs, especially if a rhizoidal function is assumed, and under these circumstances two hairs may be situated side by side, but this is very different from the usual paired condition. Sometimes the hairs are short and spine-like with strongly thickened walls, yet this type of hair is exceptional, most of them being of the usual slender type and measuring 0.09–0.15 mm. in length by about 10 μ in width. They are truly marginal in position.

The costa, as described by Schiffner, is uniform in structure, being bounded both dorsally and ventrally by two rows of cortical cells. The alar cells are unusually small, averaging about 28 $\times$ 24 μ, although somewhat larger cells are often interspersed among the others. The walls are distinctly thickened and show indistinct trigones and occasional intermediate thickenings.

The male plants bear sexual branches in some abundance. The latter are oval to globular in form, measuring usually 0.3–0.35 mm. in length by 0.25–0.35 mm. in width and their cells are but slightly smaller than those of the vegetative thallus. Although the costa is strongly incurved the apex of the branch does not usually approach the base very closely. No appendicular organs are present except the slime-papillae.

The female branches are broadly obovate and deeply indented at the apex. They are mostly 0.3–0.35 mm. long by 0.45–0.6 mm. wide, and their concave halves approach each other so closely before fertilization that their margins are almost in contact. Ventral hairs are usually completely absent, but in two instances a single such hair was seen growing out from the thickened median portion. Marginal hairs, on the contrary, are fairly abundant, and represent outgrowths of small cells, just as in a normal vegetative thallus. They are mostly short and spine-like, with strongly thickened walls. The calyptras at maturity are mostly 1.5–2.5 mm. long and 0.7–0.85 mm. in diameter.

Their relatively short hairs are densely crowded in the upper part but more scattered below the middle.

Although *M. magellanica* is undoubtedly a close relative of *M. hamata*, as Schiffner states, it bears a strong superficial resemblance to small forms of the variable *M. decrescens*, owing to its subterete thallus with marginal hairs borne singly. Differences in the costa will at once serve to separate the two species. In *M. magellanica* the cortical cells are definitely in two rows both dorsally and ventrally, and the boundary between the costa and the unistratose wings is abrupt; in *M. decrescens*, although the cortical cells may be in only two rows both dorsally and ventrally, this condition is exceptional, the number of rows being usually more than two, and the boundary between the costa and the unistratose wings is often gradual, the two being separated by a narrow band two or three cells thick. *M. decrescens* is further distinguished by its larger alar cells with thinner walls, and by the sharp contrast in size between the cells of the vegetative thalli and those of the male branches.

11. METZGERIA HAMATA Lindb.

Metzgeria linearis Lindb. Acta Soc. Sci. Fenn. **10**: 494. 1875. Not *M. linearis* (Sw.) Aust.
Metzgeria hamata Lindb. Acta Soc. F. et Fl. Fenn. **12**: 25. *f. 25.* 1877.
Metzgeria leptoneura Spruce, Trans. Bot. Soc. [Edinburgh] **15**: 555. 1885.
Metzgeria nitida Mitt. Jour. Linn. Soc. Bot. **22**: 243. 1887.
Metzgeria australis Steph. Hedwigia **28**: 267. 1889.

SPECIMENS EXAMINED: Corral, 1905, *Thaxter 34* (H., Y.); Huafo Island, 1908, *Skottsberg 253* (U., as *M. albinea*, and listed under this name by Stephani, **24**, p. 10); Newton Island, 1896, *Dusén 113* in part (B.); Punta Arenas and Tuesday Bay, Straits of Magellan, 1876, *Naumann* (S., listed as *M. linearis* by Schiffner, **16**, p. 42); Staten Island, 1882, *Spegazzini 65* in part (Massal., Y., **11**, p. 257). The material from Corral is mostly in a juvenile condition, many of the thalli being narrow and etiolated and lacking costae completely. In a few cases, however, the distinctive features of *M. hamata* are clearly apparent.

The following additional Chilean stations may be cited from the literature: near Puerto Varas, *Dusén* (**20**, p. 20); Wollaston Island, *Hariot* (**2**, p. 246); Hermite Island, *Hooker* (**10**, p. 27).

The geographical distribution of *M. hamata* is very extensive in both hemispheres. In Europe it seems to be restricted to Ireland and western Great Britain with an extension northward to the Faroe

Islands. In Asia it occurs abundantly in the Himalayas and is found also in Japan, Java and Sumatra. In America its northernmost station, so far as known, is in Alaska. It reappears in the Allegheny Mountains, although rarely collected there, and seems to attain its most vigorous development in Jamaica and other West Indian islands. Although not yet known from Mexico it occurs in Guatemala and Costa Rica and has been reported in South America from British Guiana and Brazil and along the chain of the Andes from Colombia to Bolivia. In Chile, as noted above, its range extends far into antarctic regions. It has been cited also from New Guinea and New Zealand.

The following characters of *M. hamata*, emphasized by Lindberg in his descriptions, are perhaps the most important: the dioicous inflorescence; the convex to subterete thallus with revolute wings; the crowded marginal hairs, usually arising in pairs; the wings otherwise destitute of hairs; the costa bounded both dorsally and ventrally by two rows of cortical cells and bearing hairs on its ventral surface. These characters, in spite of the wide distribution of the species, are found with remarkable constancy. There is, to be sure, a considerable range of variation in the convexity of the thallus and in the abundance of the hairs, especially those of the costa, but this would naturally be expected. When the hairs are considered in more detail they are found to vary in certain of their features. In the more typical plants the hairs of a marginal pair diverge widely and are more or less strongly curved, the concavities of the curves being directed downward or away from the edge of the wing. In subterete thalli a fairly dense weft of hairs may thus be formed, partially concealing the costa. This typical condition, however, is by no means constant; in many thalli the hairs are either straight or irregularly curved, or contorted and extend in various directions (Fig. 10, A–E). When the hairs are sparingly developed, some of them may arise singly; when they are unusually crowded, some of them may be in three's or four's (Fig. 10, E).

The cells of the wings have delicate walls, sometimes with minute and inconspicuous trigones, and vary a good deal in size. It is not unusual, in fact, for the cells in one part of a thallus to be considerably larger than those in other parts, just as in *M. decipiens* and other species. According to the writer's measurements $50 \times 37\ \mu$ would express the average size of the cells, although Stephani's figures, $65 \times 50\ \mu$, and Lindberg's, $50–65\ \mu$, are both a little higher.

According to Lindberg the male branches, which seem to be rarely present, are smooth on the wings and bear a very few short hairs on

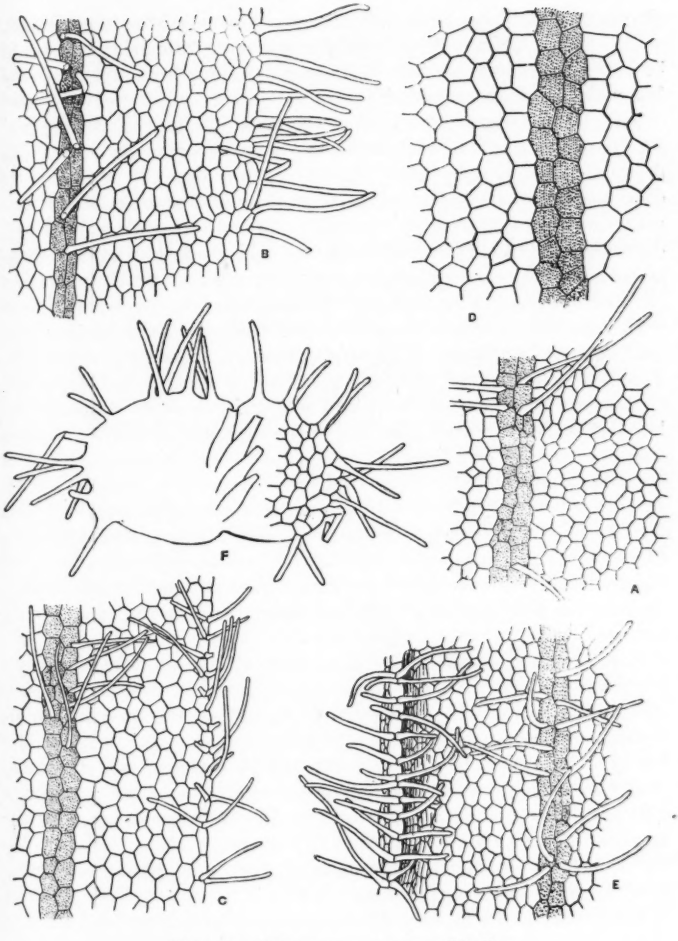

FIG. 10. METZGERIA HAMATA Lindb.

A–E. Portions of thalli, all except D ventral view, × 50. F. Female branch, × 50. A was drawn from a specimen collected at Punta Arenas by Naumann; B, from a specimen collected at Corral by Thaxter, No. 34; C, from the type material of *M. nitida;* D, from a New Zealand specimen of *M. nitida* collected by Colenso, No. 1100; E and F, from a specimen collected at Mabess River, Jamaica, by the writer, No. 306.

the costa. Stephani describes the branches as hairless throughout, and the writer has been equally unable to demonstrate hairs. It would be unwise, however, to draw definite conclusions from the relatively few male branches examined.

Female branches are much more common than male branches, and Lindberg's description brings out their most important features. He describes them as hairy along the margin and ventrally in the thickened median portion but as hairless elsewhere and adds that the marginal hairs occur singly and that they are very long, crowded, decurved and divaricate. The writer can confirm most of these statements but has demonstrated, in several cases, the occurrence of the hairs in pairs (FIG. 10, F). The calyptra, which is covered over with long hairs, presents few distinctive features; capsules have not yet been studied in detail; and gemmae are apparently never produced.

Stephani's record for the closely related species, *M. albinea*, was based on a specimen from Huafo Island, collected by Skottsberg. Since this specimen differs from *M. albinea* in being dioicous instead of autoicous, and since it shows the other distinctive features of *M. hamata*, it is included in the list of specimens given above. His record for *M. nitida* was based on a specimen collected by Naumann in the Straits of Magellan. In all probability it was an original specimen of Schiffner and Gottsche's *M. magellanica*, since this species is definitely cited as a synonym of *M. nitida*, but nothing to this effect is explicitly stated.

In the writer's opinion *M. nitida*, although recognized as valid by Stephani and others, is a synonym of *M. hamata*. Mitten's original description is brief and unsatisfactory, stating merely that the thallus is dichotomous; that the costa is bounded both dorsally and ventrally by two rows of cortical cells; that the margin bears a few cilia, arising singly or in pairs; and that the cells are hyaline, smooth, and four times as large as those of *M. furcata*. In a supplementary note the further information is given that the species is almost exactly like *M. furcata* in appearance, except that the larger and more translucent cells give it a shiny aspect.

The original description cites only two specimens: "Australia, Apollo Bay, *Sir F. von Mueller*," and "New Zealand, *Rev. W. Colenso*, on a specimen of *Homalia pulchella*, a 279." In the Mitten Herbarium the *M. nitida* cover contains a series of specimens from Australia, Tasmania, and New Zealand and also a few where no locality is indicated. One of the Australian specimens is labeled, "*Jungermannia 87*,

Apollo Bay," and is presumably the first of the specimens originally listed. It may therefore be regarded as the type of the species. This specimen is unfortunately fragmentary and is nearly destitute of sexual branches, the few present being poorly developed. The thallus is almost plane, and the costa shows the four rows of cortical cells — two dorsal and two ventral — as called for in the description (FIG. 10, C).

The alar cells are in most regions rather large, measuring mostly 65–70 μ in length by 50–55 μ in width, but cells as short as 55 μ (or even slightly shorter) are not infrequent and may occupy considerable areas in thalli where most of the cells show the higher measurements. It will be seen that these figures are appreciably higher than those of the writer for typical *M. hamata*. Trigones are scarcely discernible. When the marginal hairs are abundant they occur in pairs, slightly displaced to the ventral surface, and there may be a pair between every two marginal cells; when the marginal hairs are scattered they usually occur singly, and long stretches of the thallus may be wholly free from hairs. The costal hairs tend to be less numerous than the marginal hairs but are sometimes crowded. At their best development the hairs are long and flexuous, attaining a length of 0.3–0.4 mm.

Several of the New Zealand specimens in the Mitten Herbarium were collected by Colenso but No. 279 is not present. There is, however, in the herbarium of the New York Botanical Garden, a specimen collected by Colenso and received from Kew, that closely agrees with the Apollo Bay specimen. This bears the number 1100. It has a slightly convex thallus, the margins being subrevolute, and the marginal hairs in exceptional instances arise in three's or even in four's. The alar cells of this specimen average about 70 $\times$ 55 μ (FIG. 10, D).

If these two specimens were the only ones to be considered it might appear as if *M. nitida* could be separated from *M. hamata* by its larger leaf-cells. Other specimens, however, from Australia and New Zealand, show that this distinction is inconstant. Although agreeing with the Apollo Bay specimen and No. 1100 in other respects these specimens have distinctly smaller cells. In one Australian specimen, collected by Hartmann, for example, they average about 49 $\times$ 40 μ; in another, collected by Lucas, about 54 $\times$ 40 μ; in a New Zealand specimen without the collector's name, about 42 $\times$ 36 μ, etc. It is clear, therefore, that the distinction in the size of the cells breaks down, and since no other more important and constant distinction has been brought forward, the two species are evidently identical.

Stephani's *M. australis*, which he at one time regarded as a synonym

of *M. nitida* and which is here included among the synonyms of *M. hamata*, was based on a series of five specimens, one from Lord Howe's Island, collected by De Camera, and the others from various parts of Australia. In the Mitten Herbarium none of the Australian specimens listed by Stephani (in his original description) are represented, but a specimen collected by De Camera on Lord Howe's Island is included in the *M. australis* cover. This specimen is fragmentary and hardly determinable, but its marginal hairs are borne singly. It disagrees therefore with *M. hamata* but it disagrees equally well with Stephani's description of *M. australis*, according to which the hairs are normally borne in pairs. The other characters brought out are the following: a dioicous inflorescence; a convex thallus with abruptly recurved margins; ventral hairs restricted to the costa; cortical cells of costa in two rows both dorsally and ventrally; alar cells averaging about 45 μ. These are all characters of *M. hamata*, as Lindberg's description clearly shows, and no differential characters of importance are indicated. Whether the specimen from Lord Howe's Island in the Mitten Herbarium is identical with the one listed by Stephani could only be determined by a comparison. If they should be identical it would simply prove that his original *M. australis* was an aggregate.

In its convex thallus and in the structure of its costa *M. hamata* bears a certain resemblance to the smaller *M. magellanica*. In *M. hamata*, however, the marginal hairs are normally borne in pairs, the alar cells average about 50 μ in length and the costa is hairy below; while in *M. magellanica* the marginal hairs are borne singly, the alar cells average about 28 μ in length and the costa is naked.

It will be seen from the preceding pages that the following valid species of *Metzgeria*, although reported from Chile by earlier writers, are not here recognized as members of the Chilean flora; *M. conjugata*, *M. furcata*, *M. albinea*, *M. Liebmanniana*, and *M. pubescens*. In the case of the last three species the Chilean records have all been carefully investigated, usually by means of the actual specimens upon which they were based, and found to rest on incorrect determinations. The same thing is true of most of the records for the first two species, but one record for *M. conjugata* and three for *M. furcata* remain to be further considered.

The record for *M. conjugata* is the following: Chile, *Hahn* (see **19**, p. 951). The specimen in the Boissier Herbarium, upon which this

record was based, bears the name *M. conjugata β violacea* and was collected at Valdivia. It agrees in all essential respects with a specimen in the Schiffner Herbarium, likewise collected at Valdivia by Hahn and coming originally from the Jack Herbarium. Both specimens are sterile and, although hardly in a condition to be determined, are surely not *M. conjugata*. Their distinct bluish coloration might seem to indicate *M. violacea*, but the complete absence of gemmae does not support this idea. The wings of the thallus, moreover, are broader than is usual in *M. violacea* and their margins are scarcely if at all revolute. A specimen in the herbarium of the New York Botanical Garden, which is said to have been collected in Peru by Lechler, adds to the uncertainty. This specimen is a mixture of *M. violacea* and a species strongly resembling the Valdivia specimens. The material of this species, however, shows scattered dorsal gemmae on broad thallus-branches and is thus clearly distinct from *M. violacea*. Unfortunately the plants are not only too fragmentary for description but their identity with Hahn's specimens, which bear no gemmae, can not be regarded as definitely established.

The records for *M. furcata* are the following: Cape Horn, *Hooker* (see **8**, p. 480, as *Jungermannia furcata*); Basket Island, *Spegazzini* (see **11**, p. 257); and Chiloé, *Skottsberg* (see **19**, p. 10). Hooker's material of "*J. furcata*" in the Mitten Herbarium, representing a part of the original collection, is made up very largely of *M. decipiens* (see page 296), although a slight admixture of *M. decrescens* is present (see page 279). Since Lindberg found *M. hamata* in the same collection (see page 315) it is possible that still other species may have been included. This possibility, however, is rather remote, and it seems justifiable to conclude that Hooker and Taylor's record was wholly based on incorrect determinations. Regarding the Basket Island and Chiloé records the writer can make no statements, since the specimens involved have not been available for examination.

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Index to Species.

The names of recognized Chilean species and the numbers of pages on which descriptions occur are printed in black-face type; the synonyms are printed in italics.